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data report.

STEP-I EXPEDITION,
15 September - 14 December 1960 •
Preliminary Report •
Part I. Physical and Chemical Data •

Sponsored by
National Science Foundation
Office of Naval Research
Inter-American Tropical Tuna Commission
U. S. Bureau of Commercial Fisheries

SIO Reference 61-9
16 January 1961

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PRELIMINARY REPORT

STEP-I EXPEDITION

15 September - 14 December 1960

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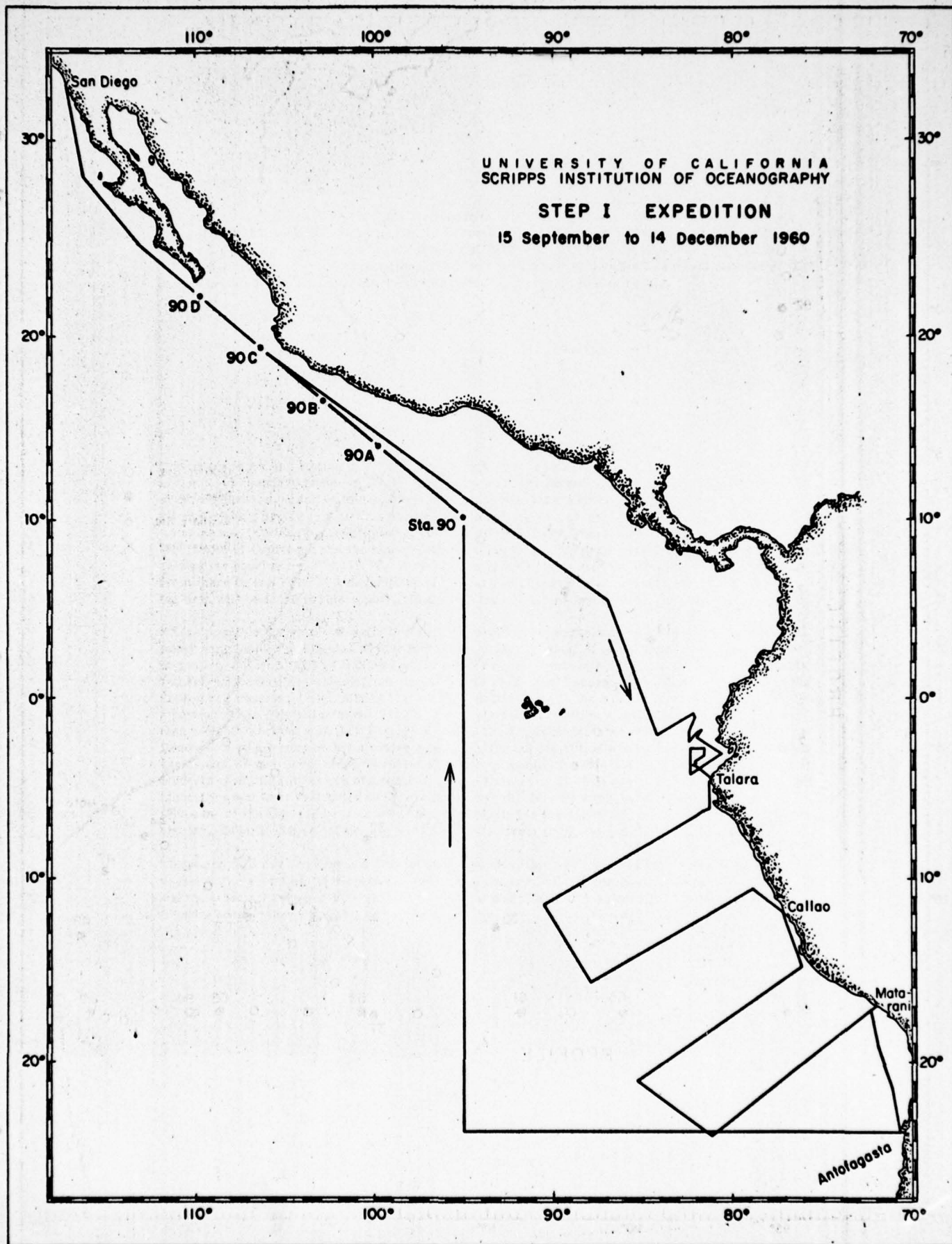
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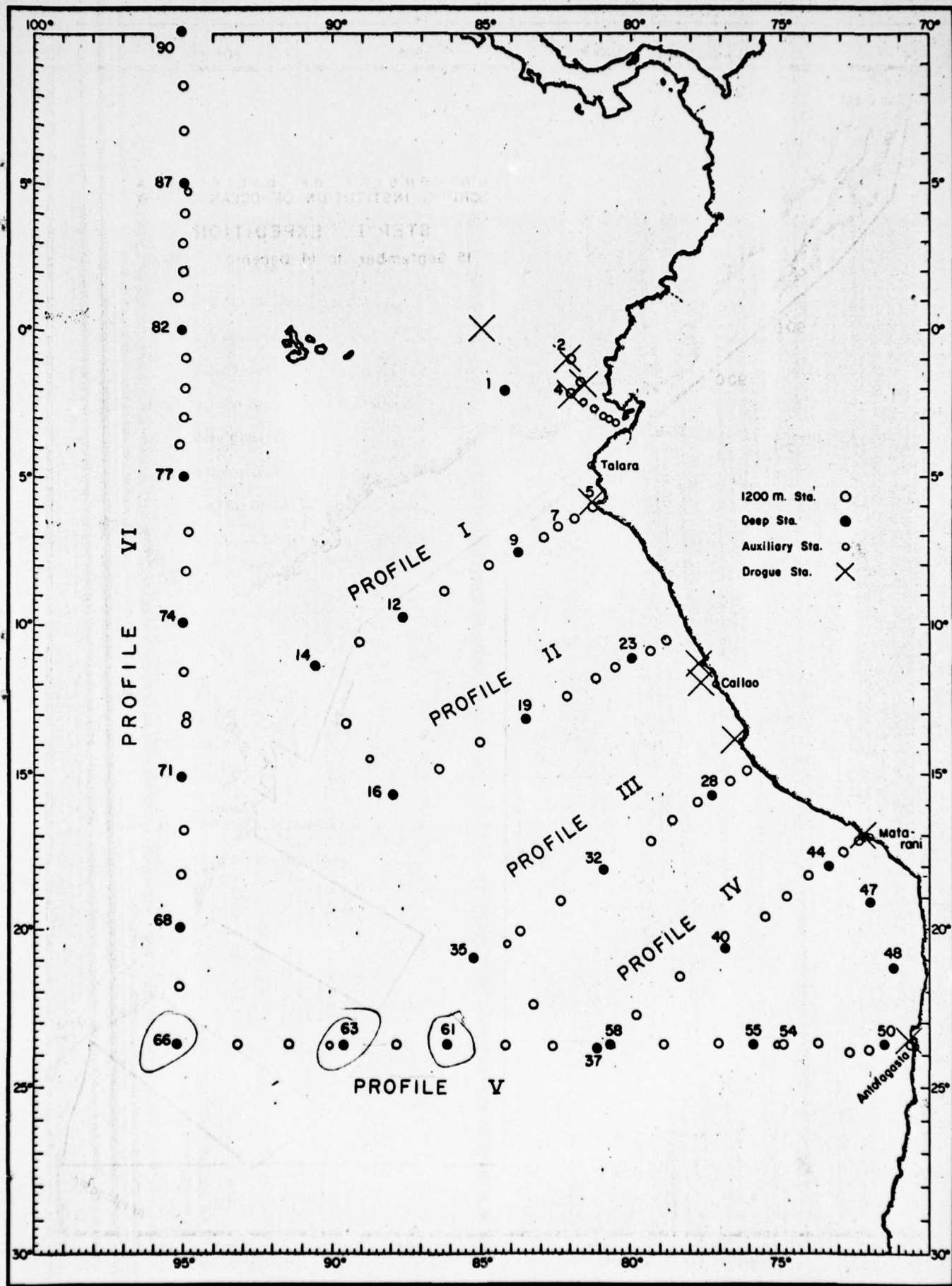
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INTRODUCTION

The STEP-I Expedition of the Scripps Institution of Oceanography, University of California, took place during the period 15 September to 14 December 1960 aboard R/V Horizon. Sponsorship and financial support were provided by the Bureau of Commercial Fisheries, the Inter-American Tropical Tuna Commission, the National Science Foundation and the Office of Naval Research. The purposes of the expedition are set forth in a succeeding section of this report.

The itinerary of the expedition was as follows:

15 September	departed San Diego
5 October	arrived Talara
21 October	arrived Callao
9 November	arrived Matarani
14 November	arrived Antofagasta
14 December	arrived San Diego

The ship's track and station plan are shown in Figures 1 and 2. Prior to arrival in Talara a study of the north boundary region of the Peru Current was carried out. Between Talara and Antofagasta, drogue measurements of subsurface currents were made at six locations, and four one-thousand-kilometer-long profiles of various oceanographic measurements were made. After departure from Antofagasta, two long oceanographic profiles were made, one from the coast to the intersection of the Tropic of Capricorn and the ninety-fifth west meridian, and the second from that point northward across the equator to 10°N, 95°W. A reduced program of scientific observations was carried out from there to San Diego. A description of the various observational methods and tables of resulting data will be found in this report. Biological investigations and data will be reported in Part II.

Where possible, cooperative activities with other scientific organizations were arranged. Special water samples were collected at four locations for Dr. R. Cox, of the National Institute of Oceanography, England, who is making a study of the relation between chlorinity, conductivity, density and refractive index in waters from various parts of the world oceans. Dr. Jorgen Nielsen, of the Zoological Museum, University of Copenhagen, participated in the entire expedition and will study a portion of the fish collections. Mr. K. Bottom, of the expedition's scientific staff, spent more than a month working with R/V B. S. P. Bondy of the Peruvian Institute of Investigations of Marine Resources, which carried out a cruise supplementing the expedition's coverage of the Peru Current. Lieutenant Héctor Beas, of the Peruvian Navy, accompanied the expedition from Callao to Matarani. Students from the University of Arequipa and the University of Chile (Antofagasta) visited the ship's laboratory and were instructed in the methods of work. Mr. Héctor Inostroza and Mr. Lisandro Chuecas, of the University of Concepción, participated in the expedition from Callao to Antofagasta, and Mr. Eduardo Reyes, of the University of Chile, from Callao to San Diego.

The success of any oceanographic expedition depends ultimately on the effectiveness of its research vessel. The scientists of the STEP-I Expedition are particularly indebted to Captain Barnes Collinson and the other officers and men of R/V Horizon for their skillful seamanship, efficient operation, friendly cooperation and unflinching assistance.

Warren S. Wooster
La Jolla, California
15 December 1960

SCIENTIFIC PERSONNEL

Barrett, Izadore		IATTC
Beas, Héctor	(Callao-Matarani)	Peruvian Navy
Blackburn, Maurice, D.Sc.	(San Diego-Matarani)	SIO
Bottom, Kenneth S.		SIO
Broadhead, Gordon	(San Diego-Callao)	IATTC
Chow, T. J., Ph.D.		SIO
Chuecas, Lisandro	(Callao-Antofagasta)	University of Concepción
Forsbergh, Eric D.		IATTC
Gilmartin, Malvern, Ph.D.		IATTC
Hart, James C., M. D.		SIO
Hester, Arthur W.		SIO
Inostroza, Héctor	(Callao-Antofagasta)	University of Concepción
Linn, Robert J.	(San Diego-Callao)	SIO
Myers, Madison		IATTC
Nielsen, Jorgen, Ph.D.		University of Copenhagen
Orange, Craig	(Callao-San Diego)	IATTC
Reith, A. Dougall	(Callao-San Diego)	SIO
Reyes, Eduardo	(Callao-San Diego)	University of Chile
Schaefer, Milner B., Ph.D.	(San Diego-Callao)	IATTC
Wooster, Warren S., Ph.D., Scientific Leader		SIO

Note: Unless otherwise indicated, personnel participated in entire expedition.

PURPOSE OF EXPEDITION

The reasons for carrying out the STEP-I Expedition are described in the following excerpts from the proposal dated 18 February 1960 to the National Science Foundation for financial support:

Since the important work of William Scoresby off the west coast of South America in 1931 (reported by Gunther, 1936), there have been several expeditions working in this region. Of these, the most important were:

Shellback Expedition in 1952,
University of California
Yasa Expedition in 1953,
Yale University
Eastropic Expedition in 1955,
University of California
Downwind Expedition in 1957-1958,
University of California

Results of the first two expeditions were described by Wooster and Cromwell (1958), and Posner (1957). In addition, since 1958, the Peruvian Hydrobiological Council has been doing some work close inshore. These operations have had various purposes, and they have all provided useful data, but they have left important gaps, either in geographical coverage or in types of observations. Several investigations of the Peru Current System, using these and other data, are now under way at the University of California. Wooster and Reid are making a comparative study of eastern boundary currents in the world ocean. Wooster is attempting to synthesize available physical and chemical data in a coherent picture of the Peru Current regime. Professor Bjerknes (UCLA) is examining the relation between meteorological and oceanographic conditions in the eastern tropical Pacific. Sund (IATTC), Brinton, and other plankton zoogeographers are analyzing the distribution of various groups of zooplankton with respect to oceanographic conditions. These studies have led to the point where a well-designed observational program could result in important advances in our understanding of the oceanography of the region. Therefore, a three-month expedition (15 September to 15 December 1960) is proposed to the region lying between 95°W and the coast of South America, and extending from the equator to the Tropic of Capricorn. The following problems will be studied on the expedition:

1. North Boundary of the Peru Current. Previous observations have shown a sharp transition in the properties of the surface

layer just south of the equator midway between the Galápagos Islands and the coast of Ecuador (Wooster and Cromwell, 1958). This transition is believed to mark the boundary between the recently upwelled waters of the Peru Current and the more typically tropical waters to the north. Measurements of surface currents made at the time by geomagnetic electrokinetograph (GEK) did not show any striking change in velocity at this transition. Thus, whether it marks the boundary of the Peru Current, either at the surface or below, remains to be established. The transition is located so close to the equator that dynamic calculations cannot be used to give a clear-cut picture of the circulation. Observations with parachute drogues and the GEK will be made. At the same time, a further check on the presence or absence of the Equatorial Undercurrent along the equator east of the Galápagos can be made. Since environmental conditions north and south of the transition are so distinct, it seems likely that a significant faunal boundary is present, as well as a sharp break in conditions for primary production. Biological studies of these phenomena, utilizing measurements of the type mentioned in (4) below, will be made. In this region there are also encountered numerous "fronts," thus providing an opportunity to study the dynamics of these little-understood features in detail.

2. Subsurface Countercurrent along Peruvian Coast.

A common feature of the vertical distribution of density on profiles off upwelling coasts is a trough in the isopycnals below the ascending isopycnals characteristic of upwelling. Such a trough is also found along the equator in association with the Equatorial Undercurrent (Knauss, 1960). Dynamic calculations show that a subsurface geostrophic countercurrent is associated with the coastal trough. Brandhorst (1959) has suggested that this circulation (which he calls the Gunther Current) has important biological effects farther south. An attempt will be made with parachute drogues to measure this current at several locations off the Peruvian coast.

3. Separation of Peru and Chilean Currents.

Bjerknes has pointed out (personal communication) that the average distribution of surface temperature in the eastern south Pacific (see Great Britain, Meteorological Office, 1956) suggests that the boundary current along the Chilean coast may be a separate phenomenon from the Peru Current.

The persistence of a wedge of warm water off Iquique, reported by Gunther (1936), and apparent in surface temperature charts and bathythermogram (BT) sections, is consistent with the suggestion. Furthermore, recent calculations by Wooster of the offshore Ekman transport due to along-shore wind stress show striking differences between the regimes north and south of the area from 20° to 25°S. A well-chosen pattern of hydrographic observations along the northern coast of Chile and extending far offshore should permit study of this possibility.

4. Productivity of Peru Current.

There are many striking indications of high productivity along the Peruvian coast. These include high surface-nutrient concentrations, large standing crops of zooplankton, the presence of a large guano industry and one of the world's greatest commercial fisheries. Both the guano birds and the fishery exploit a single species, *Engraulis ringens*, the annual catch of which, by birds and men, is of the order of 5×10^6 tons. In addition, there is a sizable commercial fishery for bonita and tuna. It is generally accepted that the high productivity is made possible by the wind-induced upwelling along the coast. No productivity measurements using the now standard carbon-14 method have been made in the region except at its northernmost limit (Holmes, Schaefer and Shimada, 1957). Such measurements, along with those for standing crops of phytoplankton, zooplankton and micronekton, and other oceanographic observations, should add to our understanding of the productivity-environment relationship in this highly productive region. Similar observations have become standard on Scripps Institution expeditions in the northeast tropical Pacific, since they were begun in 1955 and extended in 1958-1959, and are continued in that region. The work now proposed would represent an extension of this activity to the southeast tropical Pacific where an attempt would probably be made to repeat it later in other seasons and years.

5. Offshore Investigations.

From the area beyond a few hundred miles offshore from the Peruvian coast, there are only a handful of oceanographic data, physical and biological, available. Thus, it is not possible to describe the western portion of the Peru Current or the transition to the central gyre of the eastern south Pacific. Reid (1959) has recently reported evidence of a south equatorial countercurrent extending eastward to 95°W between latitudes 10°

and 15°S. At this longitude there are no detailed oceanographic data available for use in confirming the existence of this current. The ultimate fate of the large mass of water transported eastward by the Equatorial Undercurrent (Cromwell Current) to the vicinity of the Galápagos Islands (Knauss and King, 1958) is unknown, and there are few data available to permit a search for a possible discharge into the eastern south Pacific. Data from a meridional profile along 95°W, from 3°N to the Tropic of Capricorn, a latitudinal profile along this Tropic from 95°W to Antofagasta, and the extension of four profiles perpendicular to the Peruvian coast offshore for about 700 miles, will permit a study of these phenomena. Biological collections and measurements from these offshore stations will show the offshore extent of the highly productive Peru Current regime as well as adding to the zoogeographic knowledge of this unknown area.

6. Deep Circulation.

Some knowledge of the Pacific deep circulation is accumulating, from geochemical studies using carbon-14 (Suess, Rakestraw and Oeschger, 1959) and from studies of the distribution of temperature, salinity and oxygen at great depths (Wooster and Volkmann, 1960). The latter studies were hampered both by the relative scarcity of deep oceanographic stations and by the relatively poor quality of salinity measurements made by the Knudsen technique. A Paquette-type conductivity bridge will be used for salinity measurements on this expedition, and the deep stations offshore will add greatly to the material available for studies of deep circulation. Preliminary findings of the Downwind Expedition show this region to be of particular interest because of the coincidence of very high values of heat flow through the sea floor and the presence of a deep temperature minimum at a shoaler depth and with a higher temperature than found elsewhere in the Pacific (Fisher, 1958).

PROGRAM AND PROCEDURE OF OPERATIONS

1. Underway Observations

While under way to, from and between stations, continuous records of depth to the bottom (with Precision Depth Recorder), surface temperature (Taylor Recording Thermograph), and incident solar radiation (Eppley pyrheliometer) were maintained. Frequent lowerings of the 900-foot bathythermograph were made: at ten-mile intervals in regions of particular interest, at fifteen-mile intervals elsewhere. At the

time of each BT lowering, a surface salinity sample was collected. Surface weather observations were made at three-hour intervals. Bathythermograph and surface salinity observations were plotted and curves were drawn, every few days. In two regions (see later) frequent measurements of surface currents were made with the GEK. Biological collections and measurements of phytoplankton and nekton were also made (see Part II of this report).

II. Current Measurements

Throughout most of the area investigated by the expedition it is not possible to use the geomagnetic method of measuring surface currents (von Arx, 1950) because of proximity to the magnetic equator. In two regions, however, northwest of Talara near the north boundary of the Peru Current system, and offshore from Antofagasta, numerous GEK observations were made with neutral buoyant cable using a standard right-handed jog pattern.

On the equator east of the Galápagos Islands, at two locations north and two locations south of the supposed boundary of the Peru Current system, and at six locations along the coast of South America from Punta Aguja (at 4°S) to Antofagasta (Fig. 2) measurements of surface and subsurface currents were made with free-floating parachute drogues (Volkman, Knauss and Vine, 1956). Customarily there were two drogues at 10 meters, two at 150 meters and two at 300 meters (these depths were only approximate). Where possible small islands near the edge of the continental shelf were used as reference points; elsewhere a deep drogue, at approximately 1000 meters, was employed. The surface pole of each drogue was equipped with a radar reflector and the SPS-5 radar was used to determine their motion relative to the reference point. Drogues were followed for periods of 24 to 48 hours. These periods were often utilized for the making of *in situ* productivity measurements (see Part II of this report).

III. Oceanographic Stations

On the six major profiles of the expedition, stations were located at 40- to 100-mile intervals, depending on their proximity to the coast. Between 5°S and 5°N on Profile VI, stations were located at each degree of latitude. Approximately two-thirds of the stations sampled 20 levels to a depth of about 1200 meters. On these standard stations, the bottom eleven Nansen bottles were routinely sent to the depths 200, 250, 300, 400, 500, 600, 700, 800, 900, 1200 meters. The top nine bottles were placed at depths suggested by the examination of the station bathythermograph. On a third of the stations, at approximately 300-mile intervals, a second cast was made to the greatest depth possible, with bottles at 300-meter intervals. On two stations in the South American Trench, depths greater than 6000 meters were attained. On four stations extra Nansen bottles were used to collect

two-liter samples at depths of 0, 1000 and 4000 m at the request of Dr. R. Cox.

All Nansen bottles were manufactured at the Scripps Institution and were internally coated with epoxy resin to minimize problems of contamination or oxygen uptake. Delays from pretripping or posttripping of the bottles were reduced by listening to the bottle reversings, using the echo-sounder transducer as a hydrophone.

Temperatures were measured with paired protected reversing thermometers, the precision of the measurement being estimated as $\pm 0.017^\circ$ (Wooster and Taft, 1960). Eleven of the twenty bottles in use also carried unprotected reversing thermometers for the measurement of pressure. The depths of all bottle reversals were then calculated by the method described by Pollak (1950). Precision of depth determination is estimated as ± 4 m (Wooster and Taft, 1960).

Salinity determinations were made in duplicate with a UW-PNL conductivity salinometer. The precision of measurement is undoubtedly better than $\pm 0.005\%$ (Paquette, 1959). Usually only single determinations of underway surface samples were made. Cell constants were determined with Copenhagen water every second day.

All water samples from oceanographic stations were analyzed for dissolved oxygen, phosphate-phosphorus, silicate-silicon and nitrite-nitrogen. Residual water from selected stations (including all deep stations) was frozen in polyethylene containers for subsequent analyses of nitrate-nitrogen and total phosphorus.

Dissolved oxygen was determined by the Winkler method, single determinations being made routinely. A reagent blank of approximately 0.02 ml/L was found, so that all values reported in the tables are high by this amount. Precision is estimated as ± 0.05 ml/L.

Phosphate and silicate were determined by modifications of standard methods, such as those described by Strickland (1958). Nitrite was determined by the method of Bendschneider and Robinson (1952). A Beckman Model DU spectrophotometer with 10-cm absorption cells was used for these determinations. Precision of the various methods for single samples is estimated by Strickland as follows:

phosphate:	at 3 μg at/L level, ± 0.11 μg at/L at 0.3 μg at/L level, ± 0.055 μg at/L
silicate:	at 100 μg at/L level, ± 2.5 μg at/L at 10 μg at/L level, ± 0.25 μg at/L
nitrite:	at 1 μg at/L level, ± 0.032 μg at/L at 0.3 μg at/L level, ± 0.023 μg at/L

All physical and chemical data were processed at sea. A method developed by Hans Klein of the Scripps Institution was used for interpolation and computation of related parameters. After salinity was plotted as a function of temperature, a curve of thermosteric anomaly vs. depth was derived. Numerical integration of this curve gave a quantity $\Delta D'$ related to the geopotential anomaly (Montgomery and Wooster, 1954). Dissolved oxygen, phosphate and silicate were plotted as functions of thermosteric anomaly, the characteristic curves then being drawn with reference to those of neighboring stations. Depths of standard

values were read off and used to construct profiles of the various properties.

Biological observations made on these stations are described in Part II of this report.

After departure from Station 90, four auxiliary stations (90A-D) were occupied for studies of chemical properties (see Fig. 1). Thermometers were not used on these casts, but depths, which reached from 500 to 600 meters, were determined from wire angles.

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EXPLANATION OF TABLES

Most of the entries are self-explanatory, but the following comments are noteworthy:

Temperature	When the corrected readings of paired protected thermometers differed by 0.03° or less, the tabulated temperature is an average of the two values. When the difference was 0.04° or 0.05° , the values were averaged but both values are reported in a footnote. In the few cases of greater differences, the more probable value is tabulated and the other value is given as an alternate in a footnote.
Salinity	Because of the great precision of the salinometer, salinity values are reported to three decimal places, the uncertainty being confined to the last decimal place. When duplicate values differed by more than 0.006‰ , the more probable value is tabulated and the other value is given as an alternate in a footnote.
Oxygen	For the most exact work, a reagent blank of 0.02 ml/L should be subtracted from these values.
Thermosteric anomaly (δ_T)	The anomaly of specific volume with pressure terms omitted. Above 1200 m thermosteric anomaly was determined graphically; at greater depths it was determined from tables.
$\Delta D'$	A measure of geopotential anomaly determined by numerical integration of the curve of δ_T vs. depth. Omission of the pressure terms of specific volume anomaly leads to a result which differs systematically from geopotential anomaly. However, for most computations of geostrophic velocity or transport, the integrated pressure terms effectively cancel out.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm ³ /g	m	dyn m

SIO
STEP-1

HORIZON; September 29, 1960; 0245, 0601 GCT; 2°06'S, 84°14'W; sounding, 1384 fm; wind, 140°, force 13 kt; weather, drizzle; sea, very rough; wire angle, 26°, 09°.

0	18.58	34.848	4.92	1.22	9	0.32	294	0	0.000
9	18.59	34.844	5.01	1.54	11	0.35	294	10	0.029
23	18.58	34.843	4.98	1.51	10	0.36	294	20	0.059
30	18.42	34.824	4.79	1.34	8	0.35	292	30	0.088
39	17.11a)	34.919	3.52	1.42	11	0.64	254	50	0.140
57	15.73a)	35.021	2.32	1.37	14	0.27	217	75	0.193
96	14.92	35.044	2.07	1.42	16	0.04	198	100	0.244
136	14.50	35.019	1.72	2.06	18	0.02	191	150	0.340
176	14.05a)	34.998	1.54	1.99	20	0.01	183	200	0.431
193	13.72	34.978	1.02	2.17	22	0.01	178	250	0.514
237	12.75	34.942	0.23	2.76	28	0.02	162	300	0.589
290	11.30a)	34.839	0.16	2.80	34	0.00	143	400	0.717
385	9.38	34.725	0.18	3.00	46	0.00	120	500	0.827
481	8.00	34.650	0.32	3.38	53	0.00	105	600	0.925
577	6.93	34.607	0.84	3.24	61	0.00	94	700	1.014
674	6.54	34.599	0.86	3.24	67	0.00	89	800	1.097
772	5.82	34.585	0.96	3.48	78	0.00	82	1000	1.245
871	5.05	34.569	1.33	3.34	87	0.00	74		
972	4.70	34.570	1.45	3.24	95	0.00	70		
1172	4.10	34.587	1.54	3.24	110	0.00	62		
1071	4.45	34.579	1.05r	3.12	102	0.00	66		
1277	3.66	34.602	0.98r	3.58	119	0.00	57		
1483	3.00	34.623	1.08r	3.24	138	0.00	50		
1692	2.68	34.633	0.96r	3.74	146	0.00	46		
1903	2.47	34.645	1.23r	3.24	152	0.00	44		
2095	2.22	34.654	1.21r	3.14	159	0.00	41		
2296	1.98	34.669	1.29r	3.00	162	0.00	38		
2489	1.92	34.666	1.55r	3.00	159	0.00	37		

HORIZON; September 30, 1960; 0436 GCT; 1°01'S, 82°02'W; sounding, 760 fm; wind, 205°, force 4 kt; weather, overcast; sea, moderate; wire angle, 20°.

0	23.36	33.308	4.75	0.23	2	0.03	528	0	0.000
10	23.34	33.294	4.89	0.32	5	trace	529	10	0.053
24	20.22	34.066	3.54	1.08	11	0.14	391	20	0.100
41	15.16a)	35.036	1.85	2.05	18	0.04	203	30	0.138
49	15.15	35.047	2.03	1.79	17	0.03	202	50	0.189
59	14.90	35.045	2.06	1.70	17	0.02	198	75	0.239
72	14.78	35.036	2.01	1.76	17	0.02	195	100	0.287
113	14.34	34.993	1.61	1.82	17	trace	190	150	0.381
150	14.18	34.993	1.55	1.87	20	trace	186	200	0.473
202	13.74	34.970	1.49	1.92	22	trace	179	250	0.558
248	12.60	34.906	0.48	2.59	29	trace	162	300	0.634
303	11.08a)	34.816	0.17	2.52	35	trace	141	400	0.767
404	9.58	34.732	0.20	2.39	42	0.00	122	500	0.883
504	8.17	34.652	0.40	2.77	54	0.00	107	600	0.985
604	7.09	34.615	0.65	2.87	62	0.00	95	700	1.078
706	6.36	34.592	0.92	3.09	71	0.00	88	800	1.162
807	5.60	34.582	1.05	3.02	82	0.00	79	1000	1.308
909	4.84	34.577	1.35	2.89	92	0.00	70		
1012	4.56	34.583	1.37	2.99	102	0.00	68		
1215	3.81	34.600	1.62	2.99	119	0.00	58		

a) One thermometer only.

SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$10^5 \text{ cm}^3/\text{g}$	m	dyn m

3

HORIZON; October 1, 1960; 0556 GCT; 1°50'S, 81°41'W; sounding, 1175 fm; wind, 180°, force 8 kt; weather, sky obscured; sea, moderate; wire angle, 18°.

0	22.28	33.609	4.84	0.29	7	0.02	477	0	0.000
10	22.24	33.607	4.84	0.51	7	0.02	476	10	0.048
24	19.47	34.359	3.46	1.14	15	0.46	350	20	0.091
32	17.74	34.773	3.14	1.45	12	0.91	280	30	0.126
51	15.04	35.038	1.77	2.00	18	0.03	201	50	0.175
75	14.82	35.053	1.90	1.78	18	0.05	195	75	0.224
103	14.70	35.046	2.02	1.82	21	0.04	192	100	0.273
135	14.13	34.990	1.30	2.13	24	trace	186	150	0.366
175	13.50	34.967	0.93	2.26	25	trace	174	200	0.454
204	13.28	34.954	0.77	2.38	27	trace	172	250	0.538
249	12.53	34.908	0.50	2.53	31	trace	161	300	0.613
304	11.19	34.829	0.22	2.76	38	0.00	142	400	0.744
404	9.30	34.728	0.22	2.76	49	0.00	118	500	0.856
503	7.81	34.645	0.46	3.06	56	0.00	103	600	0.954
605	6.94	34.617	0.71	3.10	65	0.00	92	700	1.044
706	6.37	34.599	0.84	3.40	72	0.00	86	800	1.126
809	5.36	34.582	1.14	3.25	87	0.00	76	1000	1.272
912	4.91a)	34.578	1.37	3.21	94	0.00	71		
1017	4.68	34.581	1.38	3.28	100	0.00	69		
1222	3.72	34.606	1.62	3.66	123	0.00	57		

4

HORIZON; October 2, 1960; 0340 GCT; 2°13'S, 82°00'W; sounding, 1330 fm; wind, 160°, force 5 kt; weather, cloudy; sea, moderate; wire angle, 10°.

0	20.34	34.297	4.96	0.65	9	0.11	376	0	0.000
10	20.32	34.284	4.98	0.62	11	0.12	378	10	0.038
24	20.34	34.284	4.98	0.58	11	0.12	378	20	0.076
33	20.00	34.377	4.79	0.73	8	0.18	362	30	0.113
42	16.07b)	35.021	2.88	1.74	12	0.85	224	50	0.172
62	15.20	35.057	2.00	1.86	17	0.32	202	75	0.223
86	14.66	35.031	1.77	2.02	20	0.06	193	100	0.272
107	14.40	35.012	1.71	2.02	21	0.04	190	150	0.364
160	13.60	34.965	1.19	2.26	22	trace	176	200	0.451
213	12.81c)	34.916	0.56	2.65	28	trace	165	250	0.532
261	12.10	34.882	0.25	2.79	35	0.00	154	300	0.607
319	10.68	34.792	0.16	3.02	40	0.00	136	400	0.737
424	8.80	34.690	0.22	3.12	52	0.00	114	500	0.847
528	7.52	34.629	0.47	3.31	59	0.00	100	600	0.946
635	6.86	34.599	0.70	3.29	66	0.00	93	700	1.037
742	5.84	34.584	0.96	3.31	78	0.00	82	800	1.118
850	4.94	34.571	1.37	3.42	90	0.00	72	1000	1.262
958	4.63	34.576	1.15	3.39	99	0.00	68		
1066	4.12	34.589	1.14	3.42	112	0.00	62		
1278	3.58	34.604	1.69	3.42	126	0.00	56		

4A

HORIZON; October 3, 1960; 0319 GCT; 2°28'S, 81°37'W; sounding, 1360 fm; wind, 195°, force 4 kt; weather, cloudy; sea, missing; wire angle, 03°.

0	21.72	33.791	4.95	0.61	3	0.04	452		
5	21.71	33.781	4.85	0.42	4	0.03	452		
15	21.72	33.796	4.85	0.41	6	0.03	451		
29	16.82	34.968	2.87	1.78	11	0.69	244		
49	15.25	35.048	1.88	1.92	16	0.22	204		
74	14.82	35.048	1.74	2.01	16	0.05	195		
98	14.34	35.006	1.35	2.19	21	trace	188		
151	13.58	34.960	0.98	2.42	23	0.00	176		
200	13.12	34.937	0.71	2.54	25	0.00	169		
304	11.88	34.873	0.19	3.00	31	0.00	150		

a) One thermometer only.

b) Alternate value, 16.85°C.

c) Alternate value, 13.14°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm/g	m	dyn m

HORIZON; October 3, 1960; 0644 GCT; 2°41'S, 81°17'W; sounding, 1105 fm; wind, 215°, force 9 kt; weather, cloudy; sea, very rough; wire angle, 11°.

0	22.05	33.840	4.93	0.57	4	0.05	454
5	22.03	33.837	4.94	0.45	5	0.03	454
15	22.05	33.837	4.92	0.38	6	0.04	454
29	20.20	34.314	4.28	0.99	7	0.26	372
48	15.86	35.031	2.22	1.78	15	0.44	218
73	14.78	35.038	1.89	1.78	18	0.04	194
96	14.52	35.004	1.32	2.15	22	trace	192
149	13.72	34.967	1.03	2.39	24	trace	179
196	13.18	34.943	0.90	2.54	25	0.00	170
298	11.50	34.849	0.15	2.99	34	0.00	145

HORIZON; October 3, 1960; 1023 GCT; 2°57'S, 80°55'W; sounding, 130 fm; wind, 210°, force 3 kt; weather, overcast; sea, moderate; wire angle, 28°.

0	22.20	33.847	4.88	0.41	4	0.02	457
4	22.18	33.846	4.88	0.45	4	0.02	457
11	22.17	33.853	4.82	0.45	5	0.03	456
21	17.55	34.816	3.08	1.66	11	0.63	271
35	16.68	34.901	2.48	1.88	12	0.51	244
52	15.79	34.989	1.93	1.97	14	0.26	220
68	14.86	35.020	1.52	2.18	18	0.03	198
106	14.27	34.990	1.26	2.39	20	trace	188
137	14.16	34.987	1.16	2.41	22	0.04	185
183	13.26	34.941	0.78	- a)	- a)	- a)	172

HORIZON; October 3, 1960; 1215 GCT; 3°02'S, 80°47'W; sounding, 40 fm; wind, 210°, force 3 kt; weather, overcast; sea, moderate; wire angle, 05°.

0	22.39	33.828	4.87	0.54	3	0.00	464
5	22.37	33.828	4.87	0.53	3	0.00	463
10	22.40	33.827	4.88	0.52	3	trace	464
25	19.09	34.551	3.81	1.23	8	0.40	327
39	17.38	34.839	2.99	1.54	11	0.58	265
54	14.95	35.030	1.57	2.06	19	0.08	199

HORIZON; October 3, 1960; 1442 GCT; 3°11'S, 80°33'W; sounding, 30 fm; wind, 130°, force 4 kt; weather, overcast; sea, moderate; wire angle, 15°.

0	22.96	33.824	4.94	0.38	5	trace	480
5	22.94	33.822	4.92	0.35	7	trace	480
10	22.94	33.822	4.94	0.40	7	trace	480
24	18.96	34.518	2.88	1.48	15	0.53	326
37	15.98	34.946	1.50	2.27	25	0.36	226
52	15.81	34.968	1.38	1.93b)	27	0.42	222

a) Mud in water.

b) Possibly insufficient stannous chloride.

SIO
STEP-I

4B

4C

4D

4E

SIO

STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

5

HORIZON; October 8, 1960; 1333 GCT; 6°02'S, 81°18'W; sounding, 810 fm; wind, 120°, force 8 kt; weather, drizzle; sea, very rough; wire angle, 20°.

0	15.34	35.032	2.28	2.05	28	0.35	207	0	0.000
10	15.32	35.025	2.18	2.00	30	0.32	207	10	0.021
24	15.14	35.023	1.92	1.95	28	0.35	204	20	0.041
32	15.07a)	35.028	1.83	1.95	24	0.42	202	30	0.062
61	14.66	35.036	1.51	1.80	20	0.36	192	50	0.102
95	14.28	35.015	1.53	1.77	21	0.04	186	75	0.150
127	14.03	34.992	1.55	1.77	23	0.03	184	100	0.197
156	13.98	34.996	1.21	1.92	25	0.02	182	150	0.289
189	13.50	34.970	0.72	2.19	26	trace	174	200	0.377
208	13.29	34.956	0.52	2.16	26	0.02	171	250	0.462
255	12.84	34.930	0.39	2.27	29	0.00	165	300	0.541
311	11.57	34.854	0.15	2.54	36	0.00	147	400	0.680
414	9.84	34.750	0.14	2.92	45	0.00	126	500	0.799
515	8.18	34.664	0.15	2.87	53	0.00	106	600	0.901
619	7.05	34.619	0.29	3.11	64	0.00	94	700	0.992
722	6.12	34.581	0.48	2.97	74	0.00	85	800	1.076
828	5.47	34.578	0.81	2.97	82	0.00	77	1000	1.223
931	4.82	34.575	1.10	2.97	95	0.00	70		
1039	4.44	34.584	1.30	2.97	103	0.00	66		
1248	3.80	34.595	1.66	2.97	121	0.00	59		

6

HORIZON; October 8, 1960; 2325 GCT; 6°23'S, 81°54'W; sounding, 2695 fm; wind, 150°, force 19 kt; weather, overcast; sea, high; wire angle, 17°.

0	17.18	35.062	4.08	1.38	12	0.64	245	0	0.000
10	17.20	35.057	4.10	1.26	13	0.64	246	10	0.025
24	17.08	35.058	3.75	1.44	13	0.71	243	20	0.049
33	16.60	35.057	2.51	1.69	15	0.87	233	30	0.073
42	16.10a)	35.050	1.91	1.76	15	0.70	223	50	0.119
52	15.70	35.047	1.30	1.89	17	0.51	214	75	0.170
84	14.50	35.028	0.60	1.97	21	0.08	190	100	0.218
119	14.18	35.011	0.56	1.97	22	0.04	184	150	0.310
156	13.88	34.990	0.40	2.11	24	0.02	180	200	0.397
208	12.91	34.942	0.20	2.24	28	0.02	166	250	0.479
256	12.44	34.913	0.14	2.24	29	0.00	159	300	0.554
312	10.97	34.818	0.08	2.44	37	0.02	139	400	0.686
416	9.26	34.717	0.14	2.63	49	trace	118	500	0.799
520	7.97	34.650	0.14	2.73	56	trace	104	600	0.899
626	6.72	34.597	0.32	2.73	66	0.00	91	700	0.989
732	5.88	34.573	0.55	2.77	76	trace	83	800	1.072
839	5.29	34.562	0.81	2.84	85	0.00	77	1000	1.219
947	4.73	34.566	1.16	2.77	94	0.00	70		
1055	4.38	34.573	1.30	2.62	103	0.00	66		
1265	3.72	34.584	1.63	2.65	115	0.00	59		

a) One thermometer only.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; October 9, 1960; 0809 GCT; 6°43'S, 82°27'W; sounding, 2310 fm; wind, 155°, force 3 kt; weather, overcast; sea, very rough; wire angle, 24°.

0	17.62	35.067	4.55	1.43	14	0.44	255	0	0.000
10	17.62	35.064	4.52	1.38	16	0.44	256	10	0.026
23	17.52	35.059	4.35	1.41	15	0.46	254	20	0.051
31	15.80	35.051	1.87	1.79	18	0.51	216	30	0.075
40	14.70	35.040	0.67	2.14	21	0.31	193	50	0.117
51	14.33	35.024	0.42	2.14	23	0.04	187	75	0.163
81	13.96	35.007	0.25	2.32	25	0.04	180	100	0.208
114	13.61a)	34.983	0.17	2.30	26	0.02	176	150	0.296
150	13.34	34.968	0.19	2.19	25	0.01	171	200	0.380
199	12.89	34.944	0.12	2.45	28	0.01	165	250	0.459
244	12.08	34.891	0.12	2.45	32	0.01	153	300	0.533
301	11.38	34.853	0.11	2.52	36	0.07	144	400	0.666
404	9.54	-	-	-	-	-	-	500	0.780
508	7.98	34.646	0.12	2.86	54	0.01	104	600	0.880
613	6.95	34.601	0.27	3.01	64	0.00	94	700	0.971
719	6.08	34.578	0.40	3.01	73	0.00	84	800	1.054
823	5.38	34.565	0.83	3.01	83	0.00	77	1000	1.200
933	4.73	34.570	1.19	2.80	92	0.00	70		
1041	4.38	34.565	1.28	2.80	99	0.00	66		
1251	3.64	34.585	1.67	2.91	116	0.00	58		

HORIZON; October 9, 1960; 1914 GCT; 7°02'S, 82°56'W; sounding, 2250 fm; wind, 140°, force 13 kt; weather, cloudy; sea, missing; wire angle, 18°.

0	17.95	35.070	4.91	1.26	18	0.44	263	0	0.000
10	17.90	35.057	4.96	1.28	20	0.44	262	10	0.026
24	17.46	35.052	4.50	1.34	21	0.46	253	20	0.052
33	16.78	35.041	3.52	1.45	18	0.55	238	30	0.077
51	15.41	35.033	1.45	1.94	21	0.51	210	50	0.123
75	14.20	35.009	0.32	2.11	27	0.05	186	75	0.172
104	13.80	34.991	0.20	2.26	29	0.05	179	100	0.218
137	13.30	34.955	0.15	2.09	29	0.02	172	150	0.305
165	12.93	34.936	0.12	2.31	30	0.01	166	200	0.387
207	12.57	34.919	0.19	2.20	29	0.01	160	250	0.466
254	11.96	34.882	0.16	2.31	34	0.02	152	300	0.539
307	11.04	34.822	0.17	2.33	36	0.00	140	400	0.670
409	8.99	34.693	0.12	2.70	48	0.00	117	500	0.781
511	7.64	34.624	0.10	2.78	57	0.00	102	600	0.879
615	6.59	34.585	0.28	2.62	67	0.00	91	700	0.968
720	5.93	34.569	0.48	2.71	75	0.00	84	800	1.050
826	5.28	34.555	0.79	2.60	85	0.00	77	1000	1.196
934	4.72	34.556	1.11	2.64	91	0.00	71		
1043	4.28	34.562	1.33	2.37	105	0.00	66		
1254	3.61	34.587	1.72	2.47	118	0.00	57		

a) One thermometer only.

SIO
STEP-I

7

8

5

SIO
STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

9

HORIZON; October 10, 1960; 0314, 0610 GCT; 7°32'S, 83°48'W; sounding, 2210 fm; wind, 120°, force 3 kt; weather, overcast; sea, missing; wire angle 16°, 13°.

0	18.11	35.094	5.08	1.32	16	0.35	265	0	0.000
10	18.12	35.090	5.07	1.39	19	0.36	265	10	0.026
28	18.12	35.090	5.07	1.34	17	0.36	265	20	0.053
52	17.60	35.092	4.32	1.51	13	0.53	253	30	0.080
61	15.31a)	35.053	0.92	2.13	15	0.51	206	50	0.133
79	14.14	34.995	0.39	2.31	23	0.03	185	75	0.189
104	13.60	34.961	0.19	2.39	26	trace	177	100	0.235
131	13.12	34.941	0.14	2.47	29	trace	170	150	0.320
155	12.78	34.926	0.31	2.39	29	trace	163	200	0.400
208	11.87	34.870	0.14	2.56	33	trace	151	250	0.474
254	11.32	34.837	0.14	2.59	34	0.00	144	300	0.544
309	10.78a)	34.795	0.10	2.59	39	0.00	138	400	0.673
410	9.16	34.705	0.12	2.87	45	0.00	118	500	0.785
513	7.58	34.613	0.12	2.92	55	0.00	102	600	0.883
615	6.50	34.575	0.21	2.95	67	0.00	90	700	0.971
718	5.78	34.559	0.43	3.18	73	0.00	82	800	1.052
821	5.08	34.546	0.84	3.18	85	0.00	76	1000	1.196
925	4.64	34.552	1.15	3.05	93	0.00	71		
1028	4.24	34.565	1.39	3.05	105	0.00	65		
1235	3.58	34.583	1.68	3.05	123	0.00	57		
1137	3.88	34.568	1.53	2.79	109	0.01	62		
1442	3.16	34.611b)	1.77	2.75	132	0.01	52		
1756	2.58	34.633	2.06	2.47	147	0.00	45		
2061	2.22	34.650	2.31	2.71	157	0.00	41		
2386	1.94	34.671	2.62	2.75	159	0.00	37		
2720	1.82	34.676	2.87	2.53	162	0.00	36		
3067	1.78	34.676	2.96	2.53	160	0.00	35		
3358	1.80	34.684c)	3.01	2.49	160	0.00	34		
3651	1.82	34.684	3.07	2.57	155	0.00	34		
3945	1.83	34.686	3.14	2.49	155	0.00	34		

10

HORIZON; October 10, 1960; 1803 GCT; 8°02'S, 84°45'W; sounding, 2300 fm; wind, 140°, force 10 kt; weather, overcast; sea, very rough; wire angle, 14°.

0	18.46	35.198	5.00	1.42	11	0.53	266	0	0.000
10	18.40	35.192	4.98	1.49	13	0.54	265	10	0.027
25	18.31	35.193	4.89	1.48	14	0.54	263	20	0.053
34	18.30	35.201	5.00	1.48	12	0.53	262	30	0.079
44	18.28	35.198	4.96	1.51	10	0.52	261	50	0.132
53	18.10	35.173	4.64	1.51	11	0.53	260	75	0.189
76	14.72	35.035	0.46	2.10	24	0.03	194	100	0.237
105	14.30	35.015	0.35	2.10	24	0.01	187	150	0.328
160	13.66	34.977	0.26	2.25	26	0.00	177	200	0.416
211	13.34	34.962	0.13	2.32	27	0.00	172	250	0.501
258	12.74	34.927	0.17	2.27	27	0.00	163	300	0.580
314	11.76	34.862	0.12	2.23	33	0.00	150	400	0.721
416	9.90	34.747	0.10	2.59	44	0.00	126	500	0.840
517	7.98	34.631	0.12	2.75	54	0.00	106	600	0.943
619	6.88	34.587	0.14	2.71	64	0.00	95	700	1.034
724	5.90	34.558d)	0.32	2.79	75	0.00	84	800	1.117
827	5.20	34.547	0.72	2.98	84	0.00	77	1000	1.263
933	4.76	34.555	1.03	2.94	95	0.00	71		
1037	4.32	34.560	1.27	2.71	105	0.00	66		
1242	3.60	34.581	1.70	2.69	119	0.00	58		

- a) One thermometer only.
b) Alternate value, 34.629‰.
c) Alternate values, 34.694 and 34.700‰.
d) Alternate value, 34.565‰.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ _T	Z	ΔD'
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; October 11, 1960; 0521 GCT; 8°55'S, 86°12'W; sounding, 2210 fm; wind, 110°, force 4 kt; weather, overcast; sea, missing; wire angle, 09°.

0	19.41	35.236a)	4.97	1.19	11	0.40	286	0	0.000
54	19.24	35.228	4.89	1.28	15	0.44	282	10	0.029
78	15.00	35.041	0.13	2.26	24	0.26	200	20	0.057
87	14.40	35.014	0.07	2.26	26	0.08	190	30	0.085
92	14.20	35.009	0.10	2.26	25	0.06	186	50	0.142
97	14.05	35.006	0.10	2.43	26	0.03	183	75	0.203
107	13.75	34.976	0.10	2.38	26	0.02	179	100	0.251
132	13.27b)	34.958	0.20	2.38	28	0.01	170	150	0.338
171	12.65	34.930	0.27	2.33	28	0.02	161	200	0.418
215	12.18	34.899	0.15	2.38	30	0.02	155	250	0.495
262	11.62	34.858	0.14	2.38	34	0.02	148	300	0.567
319	10.78	34.804	0.19	2.45	37	0.01	136	400	0.697
425	8.92	34.689	0.10	2.76	47	0.01	116	500	0.809
529	7.40	34.608	0.12	2.81	56	0.01	100	600	0.907
636	6.45	34.572	0.18	2.86	67	0.00	90	700	0.996
744	5.70	34.559	0.38	2.73	74	0.00	82	800	1.077
850	5.10	34.547	0.75	3.08	86	0.00	76	1000	1.224
957	4.68	34.553	0.96	3.09	89	0.00	71		
1064	4.30	34.555	1.24	2.91	100	0.00	67		
1274	3.58	34.582	1.69	2.76	115	0.00	58		

HORIZON; October 11, 1960; 1845, missing GCT; 9°47'S, 87°39'W; sounding, 2310 fm; wind, 110°, force 13 kt; weather, overcast; sea, rough to very rough; wire angle, 27°, 34°.

0	19.22	35.311	5.07	1.70	14	0.49	276	0	0.000
23	19.16	35.298	5.06	1.48	14	0.51	274	10	0.028
41	19.16	35.292	5.04	1.44	12	0.50	275	20	0.055
58	19.08	35.313c)	5.01	1.40	9	0.52	272	30	0.083
70	15.72	35.083	1.84	1.99	11	0.36	212	50	0.137
79	14.86	35.006	0.76	2.33	17	0.07	199	75	0.197
98	13.44	34.870	0.48	2.60	20	trace	180	100	0.245
128	12.64	34.878	0.19	2.41	28	trace	165	150	0.329
156	12.18	34.896	0.38	2.49	30	trace	155	200	0.405
192	11.74	34.878	0.32	2.74	31	trace	148	250	0.478
235	11.45	34.854	0.24	2.69	34	trace	145	300	0.548
285	10.94	34.813	0.34	3.09	34	0.00	139	400	0.676
376	9.79	34.744	0.30	3.31	39	0.00	124	500	0.789
471	8.24	34.650	0.29	2.99	45	0.00	108	600	0.888
567	7.04	34.574	0.39	2.97	54	0.00	98	700	0.976
664	6.17	34.557	0.46	2.99	63	0.00	87	800	1.057
761	5.45	34.536	0.78	3.27	71	0.00	81	1000	1.203
860	4.86	34.538	1.01	3.19	84	0.00	74		
959	4.46	34.551	1.31	3.03	92	0.00	69		
1160	3.70	34.567	1.73	2.95	108	0.00	60		
964	4.54	34.567d)	1.27	2.96	88	0.00	70		
1250	3.49	34.590	1.75	2.90	117	0.00	56		
1545	2.86	34.622	2.00	2.76	132	0.00	48		
1832	2.41	34.642	2.30	2.76	144	0.00	43		
2138	2.12	34.662	2.46	2.61	150	0.00	39		
2449	1.89	34.669	2.67	2.66	151	0.00	36		
2774	1.83	34.675	2.83	2.64	156	0.00	36		
3044	1.80	34.683e)	2.98	2.66	148	0.00	36		
3319	1.80	34.685	3.06	2.59	147	0.00	36		
3597	1.80	34.695f)	3.19	2.59	147	0.00	34		
3880	1.80	34.700	3.22	2.53	147	0.00	34		

- a) Alternate value, 35.226‰.
- b) One thermometer only.
- c) Alternate value, 35.324‰.
- d) Alternate value, 34.543‰.
- e) Alternate value, 34.690‰.
- f) Alternate value, 34.684‰.

SIO
STEP-I

11

12

SIO

STEP - I

13

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₃ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻³ cm ³ /g	m	dyn m

HORIZON; October 12, 1960; 1043 GCT; 10°35'S, 89°06'W; sounding, 2210 fm; wind, 120°, force 3 kt; weather, cloudy; sea, missing; wire angle, 22°.

0	19.64	35.503	5.08	1.45	8	0.49	272	0	0.000
28	19.65	35.492	5.08	2.18	11	0.49	273	10	0.027
51	19.66	35.489	5.09	1.29	9	0.49	274	20	0.055
78	19.66	35.495	4.98	1.21	6	0.49	274	30	0.082
101	16.50	35.178	2.84	1.71	7	0.08	222	50	0.137
115	15.10	35.011	1.35	2.30	14	0.02	204	75	0.205
128	13.86	34.882	0.71	2.55	20	0.00	188	100	0.268
147	13.08	34.879	0.12	2.80	26	0.00	173	150	0.367
187	11.85	34.853	0.15	2.80	33	0.00	153	200	0.447
200	11.67	34.848	0.16	2.80	33	0.00	149	250	0.519
245	11.08	34.818	0.20	2.70	35	0.00	141	300	0.587
297	10.46	34.782	0.28	2.75	38	0.00	134	400	0.714
393	9.28	34.693	0.36	2.73	39	0.00	121	500	0.827
488	8.10	34.628	0.52	2.86	45	0.00	108	600	0.928
588	7.06	34.573	0.29	3.16	54	0.00	98	700	1.019
688	6.15	34.543	0.48	3.21	63	0.00	88	800	1.103
788	5.42	34.529	0.72	3.21	74	0.00	81	1000	1.251
890	4.83	34.530	1.09	3.16	82	0.00	74		
992	4.42	34.543	1.39	2.96	91	0.00	69		
1195	3.67	34.564	1.63	2.96	110	0.00	60		

14

HORIZON; October 12-13, 1960; 2152, 0055 GCT; 11°26'S, 90°34'W; sounding, 1860 fm; wind, 090°, force 14 kt; weather, cloudy; sea, missing; wire angle, 29°, 31°.

0	19.66	35.621	5.22	1.12	7	0.44	264	0	0.000
31	19.48	35.590	4.92	1.12	8	0.44	262	10	0.026
57	19.49	35.594	5.02	1.10	7	0.44	262	20	0.053
86	17.15	35.335	3.55	1.62	8	0.30	225	30	0.079
94	15.95	35.105	2.77	1.70	8	0.04	215	50	0.131
108	14.82	34.978	1.73	2.12	13	0.03	200	75	0.197
116	14.18	34.949	0.27	2.64	19	0.00	189	100	0.255
134	13.49a)	34.945b)	0.17	2.58	23	0.00	176	150	0.349
160	12.84	34.940	0.17	2.62	28	0.00	164	200	0.430
186	12.41	34.913	0.15	2.58	29	0.00	159	250	0.506
228	11.92	34.891	0.18	2.55	32	0.00	151	300	0.577
276	11.37	34.846	0.30	2.63	33	0.00	143	400	0.709
369	10.06	34.759	0.30	2.83	36	0.00	128	500	0.824
464	8.73	34.680	0.25	2.98	43	0.00	114	600	0.926
562	7.53	34.605	0.42	2.97	48	0.00	102	700	1.017
657	6.41	34.585	0.50	3.13	56	0.00	89	800	1.100
753	5.76	34.542	0.65	3.19	65	0.00	84	1000	1.248
852	5.09	34.527	0.92	3.14	75	0.00	77		
952	4.56	34.539	1.40	3.11	85	0.00	70		
1158	3.80	34.558	1.73	2.98	100	0.00	62		
954	4.59	34.542	1.31	3.01	89	0.00	70		
1236	3.56	34.573	1.73	2.98	114	0.00	58		
1528	2.90	34.612	1.41	2.98	132	0.00	50		
1810	2.48	34.632	2.08	2.68	143	0.00	44		
2109	2.15	34.653	2.20	2.65	149	0.00	40		
2417	1.92	34.670	2.70	2.68	154	0.00	37		
3006	1.80	34.682	2.25	2.63	154	0.00	36		
3281	1.78	34.687	3.26	2.42	148	0.00	34		
3560	1.78	34.688	2.42	2.55	149	0.00	34		

a) One thermometer only.

b) Alternate value, 34.935‰.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm/g	m	dyn m

HORIZON; October 13, 1960; 1855 GCT; 13°18'S, 89°35'W; sounding, 2160 fm; wind, 080°, force 3 kt; weather, cloudy; sea, missing; wire angle, 33°.

0	19.40	35.643	5.08	0.87	8	0.30a)	256	0	0.000
38	19.36	35.650	4.96	0.87	13	0.26	254	10	0.026
75	19.36	35.653	4.92	0.87	11	0.26	254	20	0.051
113	19.32	35.658	4.94	0.92	7	0.26	253	30	0.076
121	19.32	35.651	4.94	0.92	5	0.23	252	50	0.127
130	19.20	35.625	4.89	0.91	7	0.25	253	75	0.191
138	16.74	35.183	3.81	1.33	9	0.09	227	100	0.254
146	15.65	35.032	2.95	1.70	11	0.02	214	150	0.370
166	13.99	34.843	1.96	2.14	16	0.01	192	200	0.464
182	12.98	34.742	1.37	2.40	18	0.02	180	250	0.541
224	11.73	34.797	0.14	2.81	33	0.01	154	300	0.610
270	10.70	34.772	0.20	2.85	36	0.01	138	400	0.734
360	9.56	34.746	0.41	2.82	38	trace	121	500	0.844
450	8.42	34.656	0.44	3.04	42	trace	111	600	0.944
542	7.39b)	34.583	0.48	3.12	49	trace	101	700	1.034
635	6.34	34.538	0.61	3.21	56	trace	91	800	1.118
729	5.84	34.530	0.65	3.27	65	trace	86	1000	1.268
824	5.26	34.534	0.69	3.41	76	trace	79		
922	4.76	34.536	1.04	3.29	86	0.00	73		
1124	3.94	34.552	1.55	3.24	103	0.00	63		

HORIZON; October 14, 1960; 1905, 2113 GCT; 15°40'S, 87°58'W; sounding, 2200 fm; wind, 120°, force 4 kt; weather, partly cloudy; sea, missing; wire angle, 30°, 34°.

0	18.78c)	35.549	5.12	0.62	10	0.10	247	0	0.000
40	18.76	35.536	4.84	0.67	12	0.10	248	10	0.025
86	18.72	35.541	5.04	0.65	9	0.10	246	20	0.049
129	18.71	35.534	5.05	0.67	8	0.10	247	30	0.074
146	18.63d)	35.530	5.02	0.71	5	0.10	245	50	0.124
162	18.31	35.453	4.71	0.82	8	0.22	244	75	0.185
181	14.94	34.927	2.81	1.63	13	0.01	206	100	0.247
189	14.33	34.838	1.95	1.99	16	0.01	200	150	0.370
198	13.70	34.804	1.15	2.30	16	0.02	190	200	0.479
206	13.37	34.805	0.68	2.43	20	0.01	184	250	0.566
257	12.22	34.860	0.10	2.62	36	2.98	159	300	0.643
309	11.18	34.789	0.16	2.65	36	0.03	144	400	0.777
416	9.22	34.685	0.37	2.60	38	0.03	121	500	0.893
514	7.90	34.609	0.57	2.70	44	0.00	106	600	0.996
608	6.81b)	34.539	0.79	2.83	47	0.00	97	700	1.090
705	6.08	34.518	0.81	2.86	56	0.00	89	800	1.176
810	5.44	34.517	0.88	3.06	67	0.00	82	1000	1.328
898	4.96	34.527e)	0.97	3.03	76	0.00	75		
1009	4.48	34.540f)	1.26	3.00	89	0.00	70		
1219	3.61	34.562	1.80	2.91	107	0.00	60		
1151	3.92	34.551	1.59	2.98	101	0.00	63		
1437	3.09	34.593g)	2.01	2.73	122	0.00	52		
1733	2.56	34.616	2.45	2.65	131	0.00	46		
2018	2.22	34.641	2.68	2.40	138	0.00	42		
2324	1.98	34.668	2.96	2.40	140	0.00	37		
2638	1.84	34.674	3.08	2.40	149	0.00	36		
2960	1.81h)	34.681	3.18	2.42	150	0.00	36		
3232	1.80	34.693	3.20	2.47	151	0.00	34		
3505	1.78	34.686	3.29	2.47	151	0.00	34		
3778	1.79	34.694	3.43	2.45	143	0.00	34		
4054	1.78	34.699	3.51	2.45	137	0.00	34		

- a) Approximate value.
b) One thermometer only.
c) Alternate value, 18.86°C.
d) Alternate value, 18.81°C.
e) Alternate value, 34.519‰.
f) Alternate value, 34.553‰.
g) Alternate value, 34.604‰.
h) Alternate value, 1.86°C.

SIO

STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	%	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm/g	m	dyn m

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HORIZON; October 15, 1960; 1050 GCT; 14°49'S, 86°26'W; sounding, 2540 fm; wind, 085°, force 18 kt; weather, cloudy; sea, very rough; wire angle, 27°.

0	18.67a)	35.545	5.06	0.54	7	0.04	245	0	0.000
41	18.70	35.545	5.07	0.56	10	0.05	246	10	0.025
88	18.66	35.533	5.08	0.57	8	0.05	246	20	0.049
133	18.66a)	35.544	5.06	0.57	6	0.06	246	30	0.074
151	16.68	35.246	4.44	0.89	5	0.10	222	50	0.123
168	14.60	34.845	3.44	1.24	9	0.01	206	75	0.184
184	13.24	34.681	2.76	1.65	14	0.00	190	100	0.246
193	12.96b)	34.652	2.51	1.74	13	0.00	187	150	0.363
203	12.44	34.626	2.26	1.85	14	0.00	180	200	0.464
211	11.98	34.585	1.95	1.95	16	0.00	174	250	0.548
258	11.08	34.707	0.44	2.41	34	0.00	149	300	0.620
312	10.36	34.733	0.17	2.62	35	0.00	135	400	0.747
420	8.22	34.589	0.58	2.65	40	0.00	113	500	0.856
520	6.94	34.538	0.94	2.66	44	0.00	99	600	0.952
618	6.04	34.508c)	1.10	2.70	51	0.00	90	700	1.039
720	5.40	34.508	0.99	2.74	66	0.00	82	800	1.119
826	4.87	34.520	1.05	3.01	76	0.00	75	1000	1.261
915	4.45	34.531	1.23	3.05	86	0.00	70		
1028	4.00	34.546	1.51	2.97	100	0.00	64		
1243	3.40	34.575	1.79	2.88	113	0.00	56		

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HORIZON; October 15, 1960; 2139 GCT; 14°03'S, 85°03'W; sounding, missing; wind, 100°, force 3 kt; weather, cloudy; sea, missing; wire angle, 26°.

0	18.24a)	35.450	5.22	0.90	10	0.19	242	0	0.000
32	18.14	35.440	5.19	0.91	12	0.17	240	10	0.024
59	17.84	35.391	5.20	1.02	12	0.26	237	20	0.048
89	17.74	35.390	5.19	1.04	8	0.26	234	30	0.072
120	(16.7)	35.149	4.30	1.09	7	0.21	228	50	0.120
129	15.02	34.905	3.58	1.28	9	0.02	210	75	0.180
138	14.39a)	34.810	3.15	1.43	12	0.02	203	100	0.238
148	13.86	34.756	2.68	1.67	13	0.02	197	150	0.346
169	13.14	34.723	1.60	2.03	17	0.02	186	200	0.437
186	12.46	34.739	0.64	2.28	23	0.00	172	250	0.517
240	12.02	34.838	0.10	2.43	34	1.74	156	300	0.591
290	11.32	34.815	0.10	2.64	36	0.66	145	400	0.724
386	9.60	34.697	0.46	2.66	37	0.00	125	500	0.839
481	8.26	34.631	0.32	2.70	46	0.00	110	600	0.940
577	6.94	34.57d)	0.50	2.81	51	0.00	96	700	1.030
675	6.10	34.530	0.55	2.81	62	0.00	88	800	1.113
774	5.44	34.528	0.64	2.86	75	0.00	81	1000	1.262
876	4.94	34.527	0.98	2.96	82	0.00	75		
978	4.47	34.531	1.32	2.94	90	0.00	70		
1181	3.78	34.558	1.55	2.86	108	0.00	61		

- a) One thermometer only.
 b) Alternate value, 13.11°C.
 c) Alternate value, 34.520%.
 d) One analysis only.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

SIO
STEP-1

19

HORIZON; October 16, 1960; 1328, missing GCT; 13°11'S, 83°32'W; sounding, 2590 fm; wind, 110°, force 10 kt; weather, cloudy; sea, moderate to very rough; wire angle, 15°, 15°.

0	18.34	35.427	5.23	1.14	7	0.42	246	0	0.000
33	18.36	35.429	5.15	1.15	8	0.43	246	10	0.025
62	17.76	35.425	5.07	1.21	8	0.43	232	20	0.049
76	17.10	35.271	5.05	1.21	4	0.51	229	30	0.074
85	(16.85)	35.248	4.86	1.25	3	1.00	225	50	0.123
105	15.27	35.015	2.55	1.72	9	0.02	207	75	0.183
120	13.98a)	34.858	1.15	2.17	14	0.00	192	100	0.239
128	13.70	34.940	0.13	2.55	23	0.70	181	150	0.339
157	13.02	34.887	0.10	2.55	25	0.10	172	200	0.421
207	12.06	34.895	0.10	2.55	31	0.00	153	250	0.496
255	11.40	34.843	0.14	2.55	34	0.00	144	300	0.567
310	10.82	34.805	0.16	2.56	35	0.00	138	400	0.698
413	9.12	34.666	0.22	2.66	39	0.00	120	500	0.812
515	7.76	34.602	0.28	2.72	43	0.00	105	600	0.913
619	6.65	34.545	0.42	2.81	52	0.00	94	700	1.005
724	5.82	34.527	0.52	3.02	61	0.00	86	800	1.089
829	5.21	34.524	0.73	2.94	70	0.00	79	1000	1.239
934	4.64	34.535	1.09	2.91	85	0.00	72		
1039	4.25	34.544	1.36	2.92	92	0.00	67		
1246	3.52	34.583	1.68	2.89	113	0.00	57		
1087	4.13	34.558b)	1.40	2.98	98	0.00	64		
1391	3.23	34.596	1.82	2.88	120	0.00	54		
1706	2.61	34.622	2.24	2.70	132	0.00	46		
2008	2.26	34.651	2.56	2.50	143	0.00	41		
2332	2.00	34.662	2.72	2.53	150	0.00	38		
2663	1.85	34.678	2.90	2.49	155	0.00	36		
3005	1.84	34.679	3.00	2.50	158	0.00	36		
3290	1.82	34.684	3.05	2.50	156	0.00	36		
3575	1.80	34.685	3.22	2.51	143	0.00	36		
3861	1.80	34.685	3.35	2.45	143	0.00	36		
4150	1.80	34.689	3.44	2.45	140	0.00	34		

HORIZON; October 17, 1960; 0035, 0136 GCT; 12°25'S, 82°08'W; sounding, 2390 fm; wind, 120°, force 3 kt; weather, cloudy; sea, missing; wire angle, 22°, 24°.

20

0	18.08	35.221	5.24	1.49	14	0.51	254	0	0.000
32	17.89	35.218	5.12	1.50	15	0.50	250	10	0.025
59	17.84	35.215c)	5.06	1.50	16	0.57	250	20	0.050
82	17.48	35.218	4.51	1.50	10	0.68	241	30	0.075
91	15.26	35.035	1.53	2.06	13	0.05	206	50	0.126
101	14.28	34.919	0.43	2.41	20	0.02	194	75	0.188
123	13.08	34.891	0.13	2.60	32	3.12	172	100	0.244
142	12.70	34.888	0.12	2.60	33	3.47	165	150	0.333
174	12.22	34.875	0.12	2.61	34	1.77	158	200	0.412
202	11.88	34.865	0.12	2.58	34	0.34	151	250	0.486
247	11.34	34.832	0.19	2.58	34	0.00	144	300	0.556
303	10.60d)	34.788	0.12	2.59	39	0.00	135	400	0.685
404	9.32	34.695	0.17	2.62	43	0.00	121	500	0.798
505	7.90	34.622	0.16	2.72	49	0.00	105	600	0.899
605	6.74	34.554	0.39	2.75	55	0.00	95	700	0.989
								800	1.071
696e)	5.99	34.538	0.39	3.03	66	0.00	86	1000	1.218
795	5.26	34.529	0.73	3.03	76	0.00	79		
898	4.70	34.531	1.00	3.03	86	0.00	72		
1001	4.35	34.540	1.28	2.92	94	0.00	68		
1206	3.73	34.565	1.62	2.87	107	0.00	60		

- a) One thermometer only.
- b) Alternate value, 34.566‰.
- c) Alternate value, 35.229‰.
- d) Average of 10.63 and 10.57°C.
- e) Last five Nansen bottles recast.

11

SIO

STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

21

HORIZON; October 17, 1960; 0949 GCT; 11°51'S, 81°12'W; sounding, 2390 fm; wind, 135°, force 10 kt; weather, cloudy; sea, very rough; wire angle, 06°.

0	17.52	35.194	5.29	1.08	17	0.49	244	0	0.000
10	17.52	35.194	5.29	1.04	12	0.49	244	10	0.024
44	17.25	35.174	5.11	1.09	10	0.59	239	20	0.049
65	17.22	35.200	5.09	1.30	10	0.56	237	30	0.073
79	16.66	35.138	3.73	1.47	10	0.52	229	50	0.121
98	14.34	34.938	0.48	2.35	21	0.04	194	75	0.179
108	13.76	34.909	0.24	2.38	24	0.00	184	100	0.233
123	12.96	34.860	0.18	2.43	24	0.00	172	150	0.321
142	12.62	34.885	0.11	2.50	27	0.00	164	200	0.399
216	11.57	34.848	0.29	2.45	33	0.00	147	250	0.472
265	11.12	34.821	0.30	2.50	36	0.00	142	300	0.542
323	10.44	34.774	0.26	2.53	39	0.00	134	400	0.672
430	8.96	34.671	0.22	2.69	45	0.00	117	500	0.787
534	7.63	34.599	0.30	2.87	46	0.00	104	600	0.889
641	6.43	34.546	0.36	2.90	62	0.00	92	700	0.980
747	5.68a)	34.529	0.58	3.05	69	0.00	84	800	1.063
854	5.08	34.525	0.87	3.05	79	0.00	78	1000	1.214
961	4.66	34.536	1.03	2.92	85	0.00	72		
1069	4.14	34.541	1.41	2.91	96	0.00	66		
1280	3.48	34.573	1.72	2.92	113	0.00	58		

22

HORIZON; October 17, 1960; 1710 GCT; 11°27'S, 80°32'W; sounding, 2470 fm; wind, 130°, force 2 kt; weather, cloudy; sea, missing; wire angle, 07°.

0	17.74	35.175	5.17	1.29	8	0.52	250	0	0.000
11	17.59	35.172	5.13	1.30	8	0.51	248	10	0.025
30	17.48	35.167	5.10	1.30	8	0.52	245	20	0.050
55	16.78	35.160	4.44	1.49	7	0.79	230	30	0.074
84	14.66	34.994	0.32	2.41	20	0.07	196	50	0.122
94	14.27	34.976	0.15	2.51	23	0.29	189	75	0.177
108	14.06	34.983	0.15	2.51	24	0.45	184	100	0.226
137	13.35	34.911	0.19	2.59	27	2.05	176	150	0.316
162	13.03	34.920	0.15	2.59	28	1.61	169	200	0.398
216	12.00	34.873	0.15	2.62	31	0.00	154	250	0.475
264	11.46	34.839	0.16	2.62	32	0.00	146	300	0.547
323	10.64	34.787	0.15	2.70	36	0.00	156	400	0.678
431	9.06	34.681	0.16	2.77	40	0.00	118	500	0.794
538	7.55	34.597	0.25	2.75	49	0.00	102	600	0.896
645	6.52	34.556	0.27	2.93	63	0.00	92	700	0.987
751	5.69b)	34.538	0.42	3.14	69	0.00	83	800	1.070
859	5.04	34.537	0.82	3.11	80	0.00	76	1000	1.219
965	4.54	34.543	1.15	3.03	89	0.00	70		
1072	4.24	34.552	1.27	2.90	97	0.00	66		
1282	3.46c)	34.578	1.65	2.88	115	0.00	56		

a) Average of 5.66 and 5.71°C.

b) Average of 5.67 and 5.71°C.

c) Average of 3.49 and 3.42°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm ³ /g	m	dyn m

SIO
STEP-I

23

HORIZON; October 17-18, 1960; 2245, 0115 GCT; 11°10'S, 80°01'W; sounding, 2700+ fm; wind, 140°, force 12 kt; weather, cloudy; sea, missing; wire angle, 17°, 25°.

0	17.75	35.300	5.33	1.25	12	0.35	242	0	0.000
20	17.66	35.288	5.37	1.25	14	0.36	240	10	0.024
38	17.29	35.274	4.92	1.38	12	0.58	232	20	0.048
48	17.02	35.228	4.71	1.41	9	0.61	230	30	0.072
57	15.66	35.101	1.99	2.07	15	0.70	209	50	0.118
67	14.43	35.019	0.12	2.39	25	0.56	190	75	0.170
85	14.08	34.989	0.10	2.46	28	0.37	184	100	0.217
117	13.76	34.972	0.07	2.49	28	0.22	179	150	0.306
144	13.54	34.961	0.07	2.49	28	0.07	176	200	0.392
189	13.18	34.945	0.09	2.50	29	0.06	170	250	0.473
234	12.58	34.905	0.10	2.57	31	0.02	162	300	0.549
282	11.78	34.860	0.15	2.62	34	0.00	148	400	0.683
372	10.25	34.755	0.25	2.72	40	0.00	132	500	0.800
463	8.54	34.651	0.17	2.96	45	0.00	112	600	0.903
560	7.42	34.581	0.26	2.96	51	0.00	102	700	0.997
653	6.72	34.574a)	0.25	3.00	61	0.00	92	800	1.081
750	5.79	34.533	-	3.10	67	0.00	85	1000	1.230
844	5.16	34.531	0.68	3.10	77	0.00	78		
941	4.67	34.545	1.06	2.96	89	0.00	71		
1134	3.90	34.561	1.48	2.91	109	0.00	62		
1431	3.20	34.596	1.72	2.62	120	0.00	53		
1713	2.63	34.634	1.99	2.59	144	0.00	46		
1987	2.28	34.652	2.33	2.56	154	0.00	42		
2252	2.07b)	34.663	2.61	2.54	158	0.00	39		
2504	1.90	34.680	2.87	2.54	156	0.00	36		
2778	1.82	34.678	2.91	2.51	157	0.00	36		
2996	1.81	34.681	3.01	2.51	157	0.00	36		
3200	1.80	34.682	2.99	2.51	157	0.00	36		
3400	1.83	34.681	3.04	2.51	157	0.00	36		
3628	1.83	34.686	3.07	2.52	154	0.00	35		
3829	1.81	34.688	3.17	2.50	152	0.00	34		
4024	1.82	34.690	3.32	2.41	146	0.00	34		
4221	1.82	34.690	3.44	2.41	139	0.00	34		

HORIZON; October 18, 1960; 0853 GCT; 10°52'S, 79°29'W; sounding, 2080 fm; wind, 115°, force 2 kt; weather, cloudy; sea, missing; wire angle, 22°.

24

0	17.26	35.134	5.14	1.31	6	0.59	242	0	0.000
9	17.26	35.132	4.90	1.31	9	0.62	242	10	0.024
31	17.08	35.201	5.08	1.35	9	0.52	233	20	0.048
60	16.62	35.151	4.73	1.50	7	0.59	227	30	0.072
82	15.26	(35.05)	-	-	-	-	-	50	0.119
96	14.41	34.987	0.12	2.51	22	1.01	192	75	0.174
115	13.76	34.936	0.16	2.58	26	1.00	182	100	0.224
141	13.10	34.902	0.16	2.64	30	3.03	172	150	0.314
177	12.56	34.895	0.16	2.64	30	0.07	166	200	0.396
198	12.36	34.885	0.12	2.64	30	0.04	159	250	0.473
242	11.70	34.853	0.16	2.64	32	0.00	150	300	0.546
295	11.14	34.816	0.18	2.68	36	0.00	142	400	0.679
390	9.69	34.714	0.17	2.76	39	0.00	126	500	0.793
487	8.09	34.627	0.22	2.81	46	0.00	108	600	0.894
585	7.08	34.578	0.22	2.93	56	0.00	98	700	0.987
684	6.24	34.546	0.26	3.16	63	0.00	90	800	1.071
787	5.54	34.537	0.49	3.16	74	0.00	81	1000	1.221
890	5.00	34.535	0.81	2.97	82	0.00	76		
993	4.50	34.540	1.13	2.97	92	0.00	70		
1194	3.84	34.569	1.46	2.95	107	0.00	61		

- a) Alternate value, 34.582‰.
b) Average of 2.05 and 2.09°C.

13

S10

STEP-I

25

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; October 18, 1960; 1444 GCT; 10°32'S, 78°52'W; sounding, 500 fm; wind, 130°, force 10 kt; weather, cloudy; sea, rough; wire angle, 11°.

0	17.88	35.247	5.25	1.53	10	0.39	248	0	0.000
10	17.88	35.244	5.20	1.21	13	0.39	250	10	0.025
29	17.86	35.237	5.20	1.21	14	0.39	249	20	0.050
48	17.83	35.236	5.19	1.22	9	0.39	248	30	0.075
58	16.70	35.144	4.31	1.39	7	1.58	229	50	0.124
67	14.90	35.020	0.10	2.30	21	0.16	199	75	0.179
76	14.37	34.985	0.11	2.30	24	0.03	190	100	0.225
105	13.64a)	34.966	0.14	2.30	25	0.00	177	150	0.311
150	12.98	34.931	0.11	2.31	27	0.00	167	200	0.393
198	12.48	34.905	0.09	2.31	29	0.00	160	250	0.471
245	12.00	34.876	0.19	2.31	34	0.00	153	300	0.545
298	11.35	34.831	0.12	2.49	34	0.00	145	400	0.680
392	9.90	34.737	0.17	2.55	43	0.00	127	500	0.796
487	8.22	34.634	0.14	2.77	47	0.00	109	600	0.899
588	7.16	34.574	0.22	2.83	53	0.00	98	700	0.993
686	6.54b)	34.556	0.26	2.83	63	0.00	92	800	1.080
788	5.70	34.542	0.44	2.87	75	0.00	83	(1000)c)	(1.230)

26

HORIZON; October 28, 1960; 2315 GCT; 14°51'S, 76°09'W; sounding, 770 fm; wind, 140°, force 18 kt; weather, cloudy; sea, missing; wire angle, 11°.

0	14.74	34.884	3.86	2.06	15	0.33	206	0	0.000
10	14.54	34.865d)	3.49	2.11	16	0.32	203	10	0.020
25	13.86	34.845	2.39	2.21	18	0.32	191	20	0.040
33	13.48	34.823	1.32	2.41	19	0.33	185	30	0.059
53	13.46	34.880	1.76	2.44	21	0.91	180	50	0.096
86	12.98	34.920	0.24	2.61	27	3.17	168	75	0.140
121	12.68	34.925	0.16	2.61	29	1.92	162	100	0.182
149	12.42	34.913	0.14	2.60	31	0.67	159	150	0.263
182	12.21	34.913	0.14	2.60	33	1.57	154	200	0.341
211	12.00	34.892	0.16	2.60	33	0.32	152	250	0.416
258	11.65	34.865e)	0.10	2.61	34	0.86	148	300	0.489
317	10.98	34.814	0.18	2.64	37	0.53	140	400	0.619
422	8.48	34.646	0.18	2.86	44	0.00	112	500	0.728
526	7.10	34.570	0.38	2.86	53	0.00	98	600	0.825
632	6.13	34.546	0.53	2.91	58	0.00	88	700	0.911
737	5.20	34.539	0.75	3.06	74	0.00	78	800	0.988
843	4.79	34.548	0.94	3.09	86	0.00	72	1000	1.128
949f)	4.43	34.558	1.11	3.09	92	0.00	68		

a) Average of 13.62 and 13.66°C.

b) Average of 6.52 and 6.56°C.

c) Extrapolated by using Station 24 data below 800 meters.

d) Alternate value, 34.856‰.

e) Alternate value, 34.857‰.

f) Last two Nansen bottles on bottom.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; October 29, 1960; 0723 GCT; 15°13'S, 76°43'W; sounding, 1770 fm; wind, 127°, force 6 kt; weather, cloudy; sea, moderate; wire angle, 19°.

0	17.04	35.037	5.42	1.48	8	0.32	244	0	0.000
10	17.04	35.035	5.48	1.53	8	0.32	244	10	0.024
25	17.00	35.041	5.30	1.53	7	0.32	243	20	0.049
32	15.33	34.940	4.03	1.94	8	0.52	224	30	0.072
41	14.55	34.910	3.22	2.18	8	0.56	200	50	0.114
56	13.94	34.880a)	1.66	2.53	18	0.76	190	75	0.160
74	12.95	34.837	0.28	2.66	26	0.52	173	100	0.203
121	12.22b)	34.840	0.14	2.66	33	1.81	160	150	0.282
148	11.87	34.831c)	0.15	2.70	33	0.87	154	200	0.357
206	11.30	34.821	0.13	2.70	34	0.19	145	250	0.429
253	10.88	34.796	0.13	2.70	37	1.19	139	300	0.496
310	10.05	34.734	0.15	2.81	37	0.04	130	400	0.619
415	8.25	34.611	0.21	2.90	43	0.00	112	500	0.726
518	6.94	34.544	0.45	2.90	49	0.00	98	600	0.823
621	6.32	34.527	0.57	2.95	56	0.00	92	700	0.912
726	5.70	34.533	0.47	2.95	66	0.00	84	800	0.994
831	5.02	34.526	0.82	2.98	79	0.00	77	1000	1.140
937	4.52d)	34.557e)	1.10	2.95	86	0.00	69		
1044	4.16	34.543	1.31	2.95	95	0.00	66		
1252	3.62	34.565	1.57	2.95	110	0.00	60		

HORIZON; October 29, 1960; 1738, 1344 GCT; 15°40'S, 77°20'W; sounding, 1480 fm; wind, 120°, force 21 kt; weather, cloudy; sea, rough to very rough; wire angle, 25°, 37°.

0	17.14	35.028	5.54	1.50	8	0.28	247	0	0.000
9	17.14	35.019	5.51	1.50	8	0.28	248	10	0.025
31	16.20f)	35.002g)	5.14	1.53	10	0.39	228	20	0.050
41	14.34	34.944	2.39	2.34	18	1.41	193	30	0.074
50	13.74	34.909h)	1.16	2.60	23	2.25	184	50	0.117
71	12.82	34.846	0.15	2.60	29	0.04	171	75	0.161
98	12.38	34.861	0.12	2.65	33	2.29	161	100	0.203
130	12.08	34.869	0.14	2.66	33	2.21	155	150	0.281
155	11.90	34.863	0.15	2.68	33	1.53	152	200	0.356
195	11.56	34.842	0.14	2.67	33	1.46	148	250	0.427
236	11.10	34.808	0.16	2.68	35	1.46	142	300	0.495
287	10.44	34.767	0.14	2.75	35	0.00	133	400	0.619
380	9.20	34.675	0.17	2.88	41	0.00	121	500	0.729
472	7.75	34.608	0.25	2.90	51	0.00	104	600	0.828
568	6.96	34.562	0.25	2.90	54	0.00	98	700	0.919
665	6.22	34.531	0.62	2.90	54	0.00	90	800	1.003
761	5.44	34.509	0.83	3.00	68	0.00	82	1000	1.150
860	4.88	34.517	0.98	3.00	78	0.00	76		
960	4.53	34.538	1.19	2.98	84	0.00	70		
1159	3.76	34.555	1.70	2.90	99	0.00	61		
1023	4.18	34.527	1.37	2.93	90	0.00	67		
1323	3.37i)	34.578	1.85	2.78	110	0.00	56		
1613	2.72	34.602	2.24	2.66	129	0.00	48		
1907	2.27	34.632	2.71	2.52	135	0.00	43		
2208	2.00	34.662	3.05	2.40	138	0.00	38		
2500	1.84	34.672	3.30	2.36	143	0.00	36		

a) Average of 34.876 and 34.883‰.

b) Average of 12.19 and 12.24°C.

c) Alternate value, 34.823‰.

d) One thermometer only.

e) One sample only.

f) Average of 16.17 and 16.24°C.

g) Alternate value, 34.993‰.

h) Alternate value, 34.917‰.

i) Average of 3.35 and 3.39°C.

SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$10^5 \text{ cm}^3/\text{g}$	m	dyn m

29

HORIZON; October 29, 1960; 2245 GCT; 15°56'S, 77°51'W; sounding, 1780 fm; wind, 125°, force 21 kt; weather, cloudy; sea, missing; wire angle, 40°.

0	17.27	35.127	5.68	0.96	7	0.19	242	0	0.000
9	17.28	35.120	5.64	0.98	12	0.19	244	10	0.024
22	17.27	35.129	5.59	0.98	8	0.17	242	20	0.049
38	17.26	35.162	5.46	0.86	8	0.12	240	30	0.073
50	17.25	35.167	5.46	0.86	4	0.12	239	50	0.121
64	16.40	35.127	5.14	1.00	5	0.40	223	75	0.178
76	16.20	35.110	4.94	1.18	8	0.67	220	100	0.230
108	13.20	34.755	1.17	2.21	17	0.07	184	150	0.319
122	13.18	34.851	0.18	2.65	25	0.04	177	200	0.399
167	12.50	34.878	0.16	2.70	34	3.96	162	250	0.473
203	11.80	34.835	0.14	2.70	34	1.70	152	300	0.544
247	11.13	34.769	0.15	2.71	34	0.04	146	400	0.670
328	9.82	34.682	0.22	2.69	39	0.00	130	500	0.780
408	8.57	34.623	0.22	2.69	41	0.00	115	600	0.879
487	7.52	34.550	0.48	2.69	45	0.00	106	700	0.970
568	6.80	34.529	0.64	2.91	53	0.00	97	800	1.053
650	6.10	34.499	0.81	2.91	57	0.00	91	1000	1.201
739	5.51	34.499	0.78	2.91	66	0.00	84		
830	5.01	34.501	1.03	2.84	75	0.00	78		
1010	4.20	34.522	1.39	2.76	92	0.00	68		

30

HORIZON; October 30, 1960; 0749 GCT; 16°27'S, 78°38'W; sounding, 2000 fm; wind, 130°, force 18 kt; weather, cloudy; sea, very rough; wire angle, 24°.

0	17.22a)	35.176	5.54	0.87	3	0.14	239	0	0.000
9	17.22	35.172	5.51	0.89	3	0.14	240	10	0.024
31	17.18	35.171	5.51	0.90	3	0.14	238	20	0.048
50	16.24	35.127	5.00	1.27	5	0.71	220	30	0.072
59	15.20	35.051	2.57	1.97	13	0.58	203	50	0.117
72	13.99	34.963	0.17	2.59	30	3.94	185	75	0.168
81	13.78	34.955	0.16	2.59	30	4.74	181	100	0.213
113	13.50	34.948	0.14	2.60	30	4.58	176	150	0.300
150	13.27	34.932	0.16	2.60	30	4.41	173	200	0.384
198	12.54	34.847	0.20	2.60	33	9.04	165	250	0.464
241	12.04	34.835	0.20	2.68	35	8.14	157	300	0.541
294	11.66	34.822	0.18	2.65	35	7.58	151	400	0.681
392	10.16	34.718	0.16	2.65	35	0.00	133	500	0.800
491	8.02	34.600	0.30	2.70	43	0.00	109	600	0.903
590	6.98	34.533	0.61	2.70	46	0.00	100	700	0.997
692	6.06	34.495	0.98	2.90	50	0.00	90	800	1.083
792	5.43	34.503	0.85	2.98	65	0.00	83	1000	1.236
894	4.88	34.507	1.03	2.93	73	0.00	76		
996	4.41	34.513	1.42	2.90	80	0.00	71		
1200	3.66	34.552	1.79	2.90	99	0.00	61		

a) One thermometer only.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; October 30, 1960; 1805 GCT; 17°11'S, 79°27'W; sounding, 1930 fm; wind, 100°, force 5 kt; weather, partly cloudy; sea, moderate; wire angle, 27°.

0	17.42	35.238	5.46	0.95	7	0.22	238	0	0.000
9	17.38	35.228a)	5.47	0.95	10	0.19	237	10	0.024
44	16.80	35.175	5.40	1.01	10	0.22	229	20	0.047
87	16.23	35.119	5.05	1.28	8	0.91	220	30	0.071
97	16.10	35.094	4.90	1.31	7	1.11	219	50	0.117
104	15.30	34.968	3.95	1.56	10	0.02	211	75	0.172
122	13.14	34.684	2.05	2.01	17	0.02	189	100	0.227
138	12.85	34.731	0.92	2.36	22	0.02	180	150	0.325
163	11.88	34.663	0.71	2.36	26	0.02	166	200	0.407
189	11.88	34.786	0.22	2.60	34	trace	159	250	0.481
231	11.39	34.806	0.13	2.62	37	0.13	147	300	0.551
280	10.74	34.766	0.12	2.61	37	trace	140	400	0.679
374	9.42	34.684	0.16	2.66	45	0.00	124	500	0.792
467	8.16	34.599	0.28	2.67	42	0.00	111	600	0.894
562	7.06	34.533	0.57	2.86	48	0.00	101	700	0.986
656	6.18	34.494	0.86	2.86	56	0.00	92	800	1.070
752	5.51	34.500	0.88	2.86	63	0.00	84	1000	1.222
849	4.99	34.507	0.95	2.99	76	0.00	77		
946	4.60	34.513	1.20	2.99	87	0.00	74		
1142	3.96	34.538	1.57	2.91	101	0.00	64		

HORIZON; October 31, 1960; 1156, 0800 GCT; 18°06'S, 80°56'W; sounding, 2350 fm; wind, 100°, force 18 kt; weather, missing; sea, missing; wire angle, 25°, 29°.

0	17.33b)	35.271	5.33	0.85	-	0.11	234	0	0.000
22	17.33	35.254	5.27	0.85	5	0.12	235	10	0.023
41	17.32	35.255	5.33	0.85	5	0.12	235	20	0.047
72	16.87	35.220	5.22	1.06	6	0.26	227	30	0.070
122	14.84	34.885	3.81	1.58	-	0.04	208	50	0.117
131	14.03	34.762	2.73	1.80	12	trace	200	75	0.175
140	13.41	34.731	0.97	1.85	22	trace	190	100	0.229
158	12.98	34.751	0.64	2.35	-	trace	180	150	0.327
179	12.28	34.734	0.38	2.59	25	trace	168	200	0.414
199	12.06	34.767	0.26	2.68	30	trace	162	250	0.491
242	11.40	34.769	0.20	2.70	35	trace	149	300	0.563
297	10.66	34.739	0.16	2.70	38	0.00	140	400	0.692
396	9.08	34.653	0.18	2.80	41	0.00	121	500	0.805
496	7.42	34.534	0.74	2.80	43	0.00	106	600	0.906
598	6.36	34.468	1.32	2.80	47	0.00	96	700	0.997
699	5.64	34.480	1.22	2.88	60	0.00	87	800	1.080
800	5.16	34.495	1.09	2.99	72	0.00	80	1000	1.229
903	4.73	34.509	1.11	2.99	79	0.00	74		
1006	4.34	34.521	1.35	2.98	94	0.00	70		
1213	3.63	34.539	1.98	2.88	107	0.00	61		
1203	3.72	34.536	1.84	2.68	99	0.00	62		
1507	3.04	34.583	2.05	2.68	120	0.00	53		
1821	2.52	34.609	2.52	2.53	130	0.00	46		
2125	2.18	34.635	2.85	2.50	136	0.00	42		
2449	1.93	34.657	3.34	2.35	133	0.00	38		
2781	1.83	34.666	3.30	2.35	139	0.00	36		
3122	1.82	34.673	3.20	2.38	152	0.00	36		
3407	1.80	34.677	3.27	2.35	151	0.00	36		
3691	1.76	34.676	3.47	2.30	144	0.00	35		
3976	1.78	34.680	3.58	2.30	141	0.00	36		
4265	1.79	34.691	3.59	2.30	141	0.00	34		

a) Alternate value, 35.239‰.

b) One thermometer only.

SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm ³ /g	m	dyn m

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HORIZON; October 31, 1960; 2207 GCT; 19°04'S, 82°18'W; sounding, 2290 fm; wind, 117°, force 18 kt; weather, cloudy; sea, rough; wire angle, 24°.

0	17.81	35.279	5.42	0.68	10	0.06	244	0	0.000
9	17.80	35.272a)	5.32	0.67	14	0.06	244	10	0.024
35	17.70	35.267	5.36	0.66	13	0.06	242	20	0.049
64	17.63	35.254	5.41	0.67	9	0.06	242	30	0.073
91	17.37	35.226	5.28	0.78	6	0.09	238	50	0.121
117	17.52	35.292	5.19	0.78	7	0.15	236	75	0.182
137	16.61	35.101b)	4.86	0.85	9	0.38	230	100	0.241
146	15.64	34.912	4.60	0.98	9	0.22	222	150	0.355
164	13.52c)	34.526	3.92	1.28	9	0.00	207	200	0.455
199	11.97	34.475	2.45	1.88	14	0.00	182	250	0.537
245	10.64	34.579	1.02	2.56	28	0.00	151	300	0.609
299	10.12'	34.655	0.39	2.67	32	0.00	137	400	0.735
398	8.32	34.563	0.61	2.71	38	0.00	116	500	0.843
496	6.94	34.493	1.31	2.70	40	0.00	102	600	0.940
596	5.98	34.455	1.62	2.78	47	0.00	93	700	1.029
697	5.38	34.456	1.63	2.88	58	0.00	86	800	1.112
797	4.90	34.466	1.59	2.90	69	0.00	80	1000	1.259
899	4.50	34.494	1.57	2.96	80	0.00	73		
1000	4.14	34.510	1.81	2.93	91	0.00	68		
1206	3.56	34.538	2.07	2.85	107	0.00	60		

34

HORIZON; November 1, 1960; 1013 GCT; 20°05'S, 83°42'W; sounding, 2330 fm; wind, 110°, force 22 kt; weather, overcast; sea, very rough; wire angle, 24°.

0	18.11	35.310	5.36	0.69	8	0.04	249	0	0.000
10	18.14	35.312	5.36	0.54	8	trace	250	10	0.025
44	18.11	35.308	5.36	0.54	4	0.02	249	20	0.050
78	18.05	35.308	5.32	0.54	3	0.02	248	30	0.075
107	17.80	35.301	5.19	0.63	4	0.12	242	50	0.125
140	17.72	35.305	5.14	0.66	4	0.20	240	75	0.187
160	17.60	35.278	5.01	0.71	4	0.25	239	100	0.248
194	13.24	34.479	3.97	1.25	8	trace	206	150	0.369
204	12.84	34.488	3.36	1.45	9	0.00	197	200	0.479
213	12.52	34.502	3.13	1.63	10	0.00	190	250	0.571
262	11.56	34.633	0.90	2.53	26	0.00	163	300	0.650
319	10.24	34.631	0.53	2.68	32	0.00	141	400	0.784
425	8.11	34.524	1.00	2.65	33	0.00	116	500	0.896
530	6.78	34.472	1.70	2.64	37	0.00	101	600	0.996
636	5.94	34.451	1.63	2.85	47	0.00	93	700	1.088
744	5.36d)	34.454	1.57	2.96	56	0.00	85	800	1.173
851	4.92	34.483	1.41	2.97	68	0.00	79	1000	1.325
957	4.46	34.489	1.63	2.99	79	0.00	73		
1064	4.03	34.510	1.83	2.99	90	0.00	68		
1272	3.43	34.544	2.20	2.91	103	0.00	59		

a) Alternate value, 35.283‰.

b) Alternate value, 35.089‰.

c) Alternate value, 13.93°C.

d) Average of 5.34 and 5.38°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm/g	m	dyn m

HORIZON; November 1-2, 1960; 0201, 2320 GCT; 20°55'S, 85°16'W; sounding, 2250 fm; wind, 140°, force 12 kt; weather, cloudy; sea, very rough; wire angle, 21°, 36°.

0	18.43a)	35.248	5.33	0.50	3	0.00	261	0	0.000
10	18.42	35.253	5.33	0.43	3	0.00	261	10	0.026
27	18.14	35.232	5.35	0.41	2	0.00	256	20	0.052
50	18.11	35.240	5.36	0.38	2	0.00	254	30	0.078
74	18.10	35.238	5.33	0.48	1	0.00	254	50	0.129
102	17.94	35.205	5.19	0.52	2	trace	252	75	0.192
125	17.88	35.203	5.28	0.63	2	trace	250	100	0.256
153	17.70	35.174	5.22	0.50	2	0.10	250	150	0.381
167	17.54	35.159	5.16	0.55	2	0.22	247	200	0.505
202	17.30	35.123	5.09	0.63	3	0.33	244	250	0.614
247	12.46	34.429	3.66	1.43	6	0.00	194	300	0.701
301	10.80	34.518	1.67	2.44	19	0.00	158	400	0.845
400	9.02	34.553	0.90	2.55	27	0.00	128	500	0.963
498	7.20	34.463	1.89	2.53	28	0.00	118	600	1.065
596	6.21	34.427	2.08	2.55	36	0.00	98	700	1.158
695	5.74b)	34.457	1.53	2.85	47	0.00	90	800	1.244
795	5.05	34.449	1.78	2.85	57	0.00	84	1000	1.396
894	4.56	34.475	1.77	2.96	68	0.00	75		
995	4.29	34.494	1.84	2.80	76	0.00	71		
1194	3.65	34.539	2.08	2.80	93	0.00	62		
825	5.06	34.465	1.72	2.87	63	0.00	82		
1100	4.02	34.517	1.76	2.80	88	0.00	67		
1382	3.26	34.554	2.24	2.79	110	0.00	57		
1662	2.69	34.614	2.63	2.76	125	0.00	47		
1969	2.28	34.629	3.06	2.68	125	0.00	43		
2286	2.00	34.649	3.38	2.51	133	0.00	40		
2612	1.88	34.662	3.51	2.63	136	0.00	38		
2886	1.80	34.668	3.54	2.55	139	0.00	36		
3162	1.78	34.673	3.48	2.54	142	0.00	36		
3438	1.77	34.673	3.28	2.52	135	0.00	36		
3714	1.78	34.681	3.48	2.49	147	0.00	36		

HORIZON; November 2, 1960; 1904 GCT; 22°23'S, 83°16'W; sounding, 1450 fm; wind, 110°, force 14 kt; weather, cloudy; sea, missing; wire angle, 07°.

0	18.24	35.177	5.34	0.42	7	0.01	261	0	0.000
25	18.00	35.159	5.36	0.42	6	0.00	258	10	0.026
44	17.91	35.174	5.42	0.44	3	0.00	254	20	0.052
64	17.84	35.232	5.35	0.47	3	0.02	249	30	0.078
89	17.56a)	35.170	5.36	0.48	2	0.02	246	50	0.129
108	17.42	35.162	5.16	0.55	2	0.26	244	75	0.191
142	16.53	34.967	4.97	0.66	4	0.30	238	100	0.253
172	14.31	34.610	4.14	1.15	5	0.02	217	150	0.372
196	12.95	34.493	3.17	1.53	8	0.00	199	200	0.480
215	11.80	34.421	2.90	1.63	10	0.00	183	250	0.571
263	10.98	34.506	1.68	2.25	21	0.00	162	300	0.649
323	10.04	34.652	0.45	2.61	32	0.00	136	400	0.781
429	8.27	34.551	0.73	2.70	35	0.00	116	500	0.895
535	6.84	34.462	1.69	2.66	36	0.00	103	600	0.997
641	6.16	34.462	1.40	2.78	45	0.00	95	700	1.091
746	5.56	34.462	1.44	2.90	55	0.00	87	800	1.178
851	4.99a)	(34.465)	1.61	2.91	64	0.00	(80)	1000	1.334
958	4.48	34.479	1.79	2.85	73	0.00	74		
1064	4.14	34.504	1.90	2.80	85	0.00	69		
1275	3.53	34.542c)	2.27	2.74	98	0.00	60		

a) One thermometer only.

b) Average of 5.72 and 5.76°C.

c) One value only.

SIO
STEP-I

35

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SIO

STEP - I

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OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; November 3, 1960; 1441, 1145, 1745 GCT; 23°45'S, 81°07'W; sounding, 2160 fm; wind, 140°, force 17 kt; weather, overcast; sea, very rough; wire angle, 16°, 16°, 25°.

0	17.72a)	34.997	5.43	0.49	5	0.00	262	0	0.000
10	17.73	35.004	5.38	0.49	6	0.00	262	10	0.026
33	17.70	35.006	5.40	0.44	4	trace	262	20	0.053
53	17.58	35.025	5.44	0.44	2	0.00	257	30	0.079
86	17.44	35.051	5.42	0.46	2	0.00	253	50	0.131
129	16.84	34.995	5.17	0.57	2	0.24	243	75	0.195
149	15.86	34.784	4.93	0.72	2	0.20	237	100	0.258
168	14.50	34.580	4.62	0.91	3	0.03	223	150	0.380
191	13.00	34.393	4.22	1.34	3	trace	207	200	0.489
212	12.24	34.372	3.60	1.48	8	0.02	194	250	0.581
259	10.60	34.441	2.19	2.15	17	trace	161	300	0.658
316	9.70	34.565	1.01	2.67	27	0.00	137	400	0.788
421	7.84	34.486	1.49	2.64	30	0.00	115	500	0.899
525	6.53	34.430	2.19	2.66	31	0.00	101	600	0.998
630	5.50	34.377	3.12	2.61	32	0.00	93	700	1.090
735	5.12	34.418	2.29	2.82	51	0.00	85	800	1.174
840	4.70	34.471	2.02	2.98	63	0.00	77	1000	1.321
946	4.17	34.487	2.21	2.94	75	0.00	70		
1052	3.87	34.517	2.22	2.93	87	0.00	65		
1262	3.36	34.552	2.45	2.91	99	0.00	58		
946	4.30	34.492	1.90	2.93	80	0.00	72		
1256	3.35	34.556	2.44	2.93	101	0.00	57		
1574	2.72	34.589	2.88	2.85	113	0.00	49		
1882	2.25	34.623	3.29	2.76	122	0.00	44		
2212	1.96	34.661	3.52	2.58	125	0.00	38		
2679	1.82	34.680	3.70	2.49	131	0.00	36		
3020	1.78	34.684	3.75	2.48	134	0.00	36		
3306	1.73	34.694	3.79	2.48	134	0.00	34		
3592	1.70	34.695	3.77	2.48	134	0.00	33		
3881	1.74	34.692	3.77	2.46	136	0.00	34		
4173	1.78	34.689	3.77	2.46	136	0.00	34		

38

HORIZON; November 4, 1960; 0727 GCT; 22°43'S, 79°43'W; sounding, 2060 fm; wind, 132°, force 18 kt; weather, cloudy; sea, missing; wire angle, 23°.

0	17.39	34.953	5.53	0.51	4	0.02	258	0	0.000
24	17.41	34.950	5.47	0.52	7	0.00	259	10	0.026
61	16.96	34.920	5.51	0.52	3	0.02	250	20	0.052
92	15.74	34.775	5.20	0.77	5	0.68	234	30	0.078
115	12.75b)	34.366	4.25	1.29	3	0.02	204	50	0.129
132	11.98	34.346	3.29	1.67	8	trace	192	75	0.192
151	12.33	34.649	0.69	2.70	22	0.00	175	100	0.250
174	12.14c)	34.716	0.40	2.81	27	0.00	167	150	0.349
182	12.08	34.738d)	0.40	2.89	29	0.00	165	200	0.433
201	11.90	34.774	0.27	2.89	30	0.00	158	250	0.509
246	10.78	34.685	0.40	2.87	31	0.00	146	300	0.578
301	10.06	34.675	0.23	2.89	34	0.00	135	400	0.704
402	8.32	34.558	0.58	2.92	34	0.00	116	500	0.815
501	7.20	34.506	0.98	2.98	39	0.00	105	600	0.915
599	6.26	34.454	1.44	2.94	44	0.00	96	700	1.007
700	5.59	34.453	1.47	2.98	53	0.00	88	800	1.092
802	4.92	34.448	1.66	3.04	63	0.00	81	1000	1.242
904	4.48	34.475	1.73	3.09	74	0.00	74		
1007	4.06	34.494	2.01	2.96	84	0.00	69		
1213	3.53	34.524	2.23	2.88	97	0.00	62		

a) One thermometer only.

b) Average of 12.77 and 12.73°C.

c) Average of 12.16 and 12.12°C.

d) Alternate value, 34.729‰.

20

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

SIO
STEP-1

HORIZON; November 4, 1960; 1830 GCT; 21°31'S, 78°22'W; sounding, 2780 fm; wind, 120°, force 21 kt; weather, cloudy; sea, very rough; wire angle, 24°.

39

0	17.40	35.011	5.47	0.50	5	0.02	254	0	0.000
9	17.39	35.001	5.44	0.45	10	trace	255	10	0.025
35	17.32	34.996	5.46	0.44	5	0.02	253	20	0.051
72	17.12	34.980	5.42	0.46	4	0.03	250	30	0.076
99	16.88	34.987	5.29	0.55	2	0.16	244	50	0.127
118	16.32	34.859	5.14	0.57	3	0.48	241	75	0.190
136	14.56	34.550	4.84	0.81	4	0.06	226	100	0.251
154	12.59	34.349	3.83	1.38	6	0.02	202	150	0.364
172	11.81	34.344	2.99	1.84	10	trace	189	200	0.458
199	11.46	34.481	1.94	2.19	16	trace	172	250	0.538
245	10.64	34.583	0.90	2.63	25	0.00	151	300	0.610
299	9.90	34.606	0.54	2.82	32	0.00	137	400	0.737
399	8.24	34.524a)	0.96	2.84	31	0.00	118	500	0.848
496	7.00	34.469	1.46	2.84	36	0.00	105	600	0.947
593	6.18	34.442	1.59	2.95	42	0.00	96	700	1.038
692	5.54b)	34.459	1.51	3.03	52	0.00	87	800	1.122
791	5.08	34.454	1.57	3.15	62	0.00	82	1000	1.274
893	4.60	34.472	1.58	3.14	73	0.00	76		
995	4.20	34.493	1.79	3.02	83	0.00	70		
1201	3.54	34.524	2.15	3.02	98	0.00	61		

HORIZON; November 5, 1960; 0918, 0621 GCT; 20°37'S, 76°51'W; sounding, 2550 fm; wind, 130°, force 16 kt; weather, missing; sea, missing; wire angle, 23°, 35°.

40

0	17.21c)	35.016	5.51	0.48	5	trace	250	0	0.000
40	17.21	35.007	5.47	0.42	5	0.02	250	10	0.025
89	16.82	35.004	5.20	0.54	4	0.43	242	20	0.050
135	13.18	34.433	4.07	1.21	6	0.02	208	30	0.075
170	11.24	34.461	1.98	2.18	16	0.00	171	50	0.125
197	11.40	34.650	0.78	2.52	25	0.00	159	75	0.188
205	11.45	34.707	0.45	2.67	29	0.00	156	100	0.249
214	11.32	34.721	0.40	2.79	29	0.00	152	150	0.356
223	11.28	34.723	0.30	2.79	29	0.00	151	200	0.442
232	10.98	34.692	0.44	2.76	30	0.00	149	250	0.517
267	10.36	34.693	0.34	2.79	33	0.00	138	300	0.586
320	9.55	34.644	0.32	2.86	33	0.00	128	400	0.709
432	8.12	34.584	0.51	2.98	37	0.00	111	500	0.819
534	6.88	34.515	1.17	2.93	40	0.00	100	600	0.917
636	6.03	34.476	1.49	2.95	46	0.00	92	700	1.008
739	5.46d)	34.470	1.32	3.00	57	0.00	86	800	1.093
847	4.87	34.469	1.50	3.10	67	0.00	79	1000	1.245
939	4.42	34.485	1.67	3.07	78	0.00	73		
1055	3.96	34.504	1.92	2.99	88	0.00	67		
1273	3.34	34.547	2.22	2.99	104	0.00	58		
1113	3.90	34.519	1.96	2.98	93	0.00	66		
1410	3.12	34.571	2.37	2.94	109	0.00	54		
1716	2.57	34.607	2.74	2.79	121	0.00	47		
2012	2.26	34.629	2.84	2.78	135	0.00	42		
2329	2.02	34.649	3.02	2.60	141	0.00	39		
2656	1.88	34.655	3.25	2.59	141	0.00	38		
2991	1.83	34.667	3.33	2.60	144	0.00	36		
3273	1.80	34.672	3.52	2.53	139	0.00	36		
3554	1.75	34.672	3.68	2.50	133	0.00	36		
3839	1.75	34.678	3.70	2.50	133	0.00	35		
4129	1.77	34.668	3.68	2.53	133	0.00	36		

a) One value only.

b) Average of 5.52 and 5.56°C

c) One thermometer only.

d) Average of 5.44 and 5.48°C.

SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$10^5 \text{ cm}^3/\text{g}$	m	dyn m

41

HORIZON; November 5, 1960; 1839 GCT; 19°36'S, 75°30'W; sounding, 2430 fm; wind, 150°, force 16 kt; weather, cloudy; sea, rough; wire angle, 30°.

0	17.50	35.028	5.54	0.54	4	0.02	255	0	0.000
10	17.49	35.028	5.42	0.54	7	trace	255	10	0.026
35	16.94	35.000	5.49	0.54	4	0.06	244	20	0.051
43	16.72	34.980	5.42	0.59	4	0.17	241	30	0.076
78	16.31	35.056	5.12	0.95	3	0.67	226	50	0.125
87	16.23	35.029	5.03	0.96	3	0.85	226	75	0.183
116	13.34	34.617	2.41	1.98	10	trace	197	100	0.239
133	12.86	34.713	0.42	2.84	21	trace	181	150	0.336
157	12.42	34.774	0.27	2.98	27	trace	168	200	0.417
187	11.92	34.783	0.22	2.96	30	0.00	158	250	0.492
230	11.43	34.796	0.16	2.98	35	0.56	149	300	0.562
273	10.61	34.739	0.18	3.07	35	0.00	139	400	0.687
361	9.14	34.638	0.34	3.13	35	0.00	122	500	0.797
447	7.95	34.574	0.51	3.13	39	0.00	109	600	0.896
533	6.89	34.504	1.16	3.13	41	0.00	101	700	0.988
624	6.18	34.481	1.30	3.13	49	0.00	93	800	1.072
711	5.64	34.478	1.23	3.20	56	0.00	87	1000	1.222
800	5.14	34.482	1.30	3.23	64	0.00	81		
893	4.64	34.493	1.53	3.22	78	0.00	75		
1082	3.99	34.528	1.72	3.20	93	0.00	65		

42

HORIZON; November 6, 1960; 0154, 0249 GCT; 18°58'S, 74°48'W; sounding, 2420 fm; wind, 120°, force 10 kt; weather, missing; sea, missing; wire angle, 31°, 27°.

0	17.92	35.156	5.57	0.65	6	0.05	256	0	0.000
9	17.93	35.152	5.54	0.61	6	0.06	256	10	0.026
22	17.81	35.146	5.56	0.59	6	0.06	254	20	0.051
30	16.55	35.020	5.48	0.60	4	0.14	234	30	0.076
46	16.34	35.025	5.20	0.69	2	0.34	229	50	0.122
66	16.08	35.050	4.62	1.10	4	1.18	222	75	0.177
92	12.92	34.616	1.57	2.18	13	0.03	189	100	0.227
122	12.71	34.761	0.38	2.66	24	trace	175	150	0.313
145	12.25	34.781	0.21	2.79	29	trace	165	200	0.391
182	11.70	34.790	0.14	2.78	33	0.02	154	250	0.464
223	11.26	34.791	0.17	2.79	33	1.13	146	300	0.533
270	10.66	34.750	0.16	2.79	35	0.02	139	400	0.658
361	9.32	34.667	0.21	2.93	36	0.00	123	500	0.768
450	7.94	34.579	0.49	3.00	39	0.00	109	600	0.867
541	7.04	34.543	0.53	3.00	47	0.00	100	700	0.958
								800	1.041
683	5.76a)	34.485	1.14	3.18	54	0.00	88	1000	1.190
784	5.22b)	34.493	1.07	3.18	67	0.00	82		
886	4.64	34.504	1.29	3.13	78	0.00	74		
987	4.22	34.522	1.56	3.08	87	0.00	68		
1187	3.62	34.552	1.75	3.08	105	0.00	60		

a) Average of 5.73 and 5.78°C.

b) One thermometer only.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; November 6, 1960; 1125 GCT; 18°18'S, 74°03'W; sounding, 2050 fm; wind, 150°, force 11 kt; weather, overcast; sea, missing; wire angle, 16°.

0	17.72	35.159	5.54	0.89	9	0.11	250	0	0.000
10	17.72	35.164	5.49	0.89	12	0.11	250	10	0.025
28	17.58	35.143	5.51	0.94	9	0.12	248	20	0.050
48	16.19	34.984	4.91	1.44	10	0.37	229	30	0.075
58	14.83a)	34.878	3.65	1.81	11	1.44	208	50	0.122
67	13.76	34.772	1.89	2.16	15	0.04	194	75	0.173
95	12.80	34.813	0.13	2.72	29	0.03	173	100	0.218
104	12.80	34.824	0.14	2.74	29	0.02	172	150	0.301
140	12.40	34.865	0.10	2.80	34	4.48	161	200	0.378
204	11.46	34.804	0.09	2.80	34	1.54	149	250	0.450
249	10.87	34.782	0.13	2.80	36	1.09	140	300	0.518
303	10.06	34.714	0.12	2.80	37	trace	132	400	0.643
402	8.75	34.628	0.24	2.83	39	0.00	117	500	0.753
499	7.28	34.553	0.61	2.87	44	0.00	102	600	0.850
596	6.36	34.513	0.76	2.97	51	0.00	93	700	0.939
696	5.48	34.493	1.05	3.13	64	0.00	84	800	1.020
795	5.12	34.500	1.12	3.15	70	0.00	79	1000	1.170
896	4.80	34.514	1.13	3.15	77	0.00	75		
998	4.41	34.520	1.35	3.12	87	0.00	71		
1204	3.68	34.557	1.69	3.07	106	0.00	61		

HORIZON; November 6, 1960; missing, 1837 GCT; 17°59'S, 73°22'W; sounding, 2910 fm; wind, 150°, force 11 kt; weather, overcast; sea, missing; wire angle, missing, 23°.

0	18.95	35.109	5.43	0.46	4	0.00	284	0	0.000
10	18.96	35.108	5.41	0.45	6	trace	284	10	0.028
25	18.84	35.112	5.41	0.45	5	trace	281	20	0.057
33	16.51	34.991	5.57	0.60	5	0.08	236	30	0.083
53	16.10	35.012	4.82	0.93	4	0.75	225	50	0.130
77	13.66	34.758	0.99	2.25	16	0.09	193	75	0.183
106	13.07	34.857	0.15	2.62	29	trace	174	100	0.229
139	12.57	34.860b)	0.15	2.63	32	3.35	164	150	0.314
169	12.13	34.850	0.18	2.63	33	3.86	157	200	0.392
211	11.62	34.845	0.16	2.63	34	3.55	149	250	0.465
257	11.00	34.803	0.15	2.67	35	1.64	141	300	0.534
314	10.12	34.740	0.15	2.73	36	trace	131	400	0.659
417	8.62	34.643	0.26	2.78	39	0.00	114	500	0.769
518	7.19	34.552	0.62	2.78	44	0.00	101	600	0.868
620	6.26	34.512	0.95	2.84	50	0.00	92	700	0.957
726	5.56	34.553c)	1.03	2.90	61	0.00	80	800	1.039
830	4.95	34.509	1.12	2.96	74	0.00	77	1000	1.185
936	4.40	34.503	1.57	2.88	81	0.00	72		
1041	4.09	34.539	1.61	2.80	92	0.00	66		
1249	3.54	34.565	1.82	2.79	108	0.00	58		
1525	2.92	34.598	2.26	2.78	122	0.00	50		
1808	2.44	34.638	2.43	2.73	139	0.00	43		
2091	2.17	34.658	2.70	2.57	148	0.00	40		
2422	1.94	34.680	3.06	2.43	148	0.00	36		
2704	1.84	34.686	3.13	2.43	148	0.00	35		
2986	1.80	34.677	3.15	2.43	148	0.00	36		
3409	1.81	34.679	3.26	2.43	148	0.00	36		
3787	1.76	34.686	3.59	2.40	138	0.00	34		
4216	1.72	34.691	3.69	2.38	138	0.00	34		
4651	1.75	34.690	3.71	2.37	138	0.00	34		
5039	1.78	34.691	3.77	2.33	138	0.00	34		

- a) Average of 14.81 and 14.87°C.
b) One value only.
c) Probable evaporation.

SIO

STEP-I

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SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

45

HORIZON; November 7, 1960; 0245 GCT; 17°34'S, 72°52'W; sounding, 1830 fm; wind, 095°, force 14 kt; weather, overcast; sea, missing; wire angle, 10°.

0	18.85	35.112	5.39	0.63	4	trace	282	0	0.000
10	18.86	35.114	5.33	0.62	6	0.00	281	10	0.028
20	18.64	35.098	5.35	0.66	6	trace	277	20	0.056
29	15.03	34.794	3.29	1.59	10	1.03	219	30	0.081
38	14.00	34.717	2.46	1.87	11	0.17	202	50	0.121
48	13.49	34.730	0.95	2.33	17	0.07	192	75	0.167
78	13.15	34.866	0.13	2.68	28	0.23	176	100	0.210
126	12.48	34.862	0.16	2.68	33	4.44	164	150	0.292
165	11.86	34.811	0.16	2.66	32	0.80	155	200	0.369
213	11.30	34.803	0.16	2.65	34	2.26	146	250	0.441
259	10.62	34.759	0.16	2.65	35	0.83	138	300	0.509
317	9.98	34.715	0.17	2.70	37	0.02	130	400	0.633
421	8.44	34.617	0.25	2.77	40	0.00	114	500	0.743
525	7.08	34.539	0.65	2.76	46	0.00	101	600	0.840
626	6.12	34.498	0.94	2.77	53	0.00	91	700	0.929
732	5.49a)	34.498	1.01	2.93	63	0.00	84	800	1.013
837	4.93	34.500	1.19	2.95	75	0.00	77	1000	1.160
943	4.38	34.520	1.40	2.91	85	0.00	70		
1049	4.02	34.541	1.57	2.85	94	0.00	65		
1256	3.50	34.560	1.86	2.83	102	0.00	59		

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HORIZON; November 7, 1960; 1027 GCT; 17°12'S, 72°19'W; sounding, 580 fm; wind, 040°, force 8 kt; weather, overcast; sea, missing; wire angle, 15°.

0	18.63b)	34.864	-	0.67	9	0.02	294	0	0.000
10	18.31	34.939	5.67	0.63	12	trace	281	10	0.029
20	15.58	34.812	3.59	1.33	12	0.54	228	20	0.054
28	13.80	34.684	1.64	2.05	15	0.27	201	30	0.076
47	13.28c)	34.750	0.38	2.46	21	0.05	186	50	0.115
63	13.02	34.828	0.14	2.65	28	0.37	176	75	0.159
85	12.88	34.860	0.12	2.65	32	0.02	170	100	0.201
104	12.56	34.831	0.14	2.63	33	0.00	166	150	0.283
137	12.34	34.870	0.09	2.63	35	0.22	160	200	0.360
165	12.19	34.865	0.12	2.63	36	0.22	157	250	0.434
192	12.02	34.858	0.20	2.69	38	2.75	155	300	0.503
240	11.28d)	34.812	0.10	2.66	38	2.59	145	400	0.628
290	10.52	34.759	0.14	2.66	38	0.67	136	500	0.737
385	8.98	34.667	0.18	2.75	41	0.00	118	600	0.837
478	7.74	34.578	0.42	2.73	42	0.00	106	700	0.928
577	6.70	34.523	0.78	2.95	51	0.00	97	800	1.010
670	5.96	34.503	0.94	2.98	59	0.00	89	1000	1.158
771	5.25	34.501	1.00	2.98	68	0.00	81		
869	4.83	34.507	1.20	2.98	80	0.00	76		
972	4.38	34.521	1.36	2.98	88	0.00	70		

- a) Average of 5.47 and 5.51°C.
 b) Alternate value, 18.19°C.
 c) Average of 13.30 and 13.26°C.
 d) Average of 11.25 and 11.31°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

SIO
STEP-1

HORIZON; November 10, 1960; 2255, 1813 GCT; 19°09'S, 71°58'W; sounding, 3430 fm; wind, 145°, force 7 kt; weather, overcast; sea, missing; wire angle, 05°, 08°.

47

0	19.50a)	35.224	5.33	0.55	5	trace	288	0	0.000
25	17.40	35.020	5.85	0.57	7	0.00	254	10	0.029
45	14.28b)	34.748	1.71	1.90	16	0.32	206	20	0.057
65	13.68	34.821	0.10	2.31	21	0.20	189	30	0.084
89	13.38	34.872	0.09	2.43	29	0.60	179	50	0.127
133	12.70	34.881	0.09	2.56	33	3.89	166	75	0.175
173	12.36	34.875c)	0.12	2.55	34	3.80	160	100	0.220
217	11.83	34.850	0.10	2.56	35	3.61	152	150	0.305
265	11.28	34.816	0.08	2.56	35	2.22	144	200	0.384
323	10.54	34.765	0.08	2.59	36	0.23	136	250	0.459
428	8.82	34.651	0.18	2.65	39	0.00	117	300	0.531
532	7.38	34.540	0.68	2.74	41	0.00	104	400	0.661
636	6.35	34.514	1.10	2.75	47	0.00	93	500	0.776
740	5.53	34.507	1.16	2.76	60	0.00	84	600	0.878
844	4.97	34.501	1.33	2.80	87	0.00	78	700	0.970
1050	4.14	34.529	1.57	2.79	91	0.00	67	800	1.053
1301	3.40	34.563	1.96	2.65	109	0.00	58	1000	1.203
1553	2.85	34.604	2.27	2.58	123	0.00	50		
1817	2.44	34.631	2.61	2.45	133	0.00	44		
2108	2.15d)	34.652	2.91	2.40	138	0.00	40		
2322	2.06	34.673e)	2.88	2.40	141	0.00	38		
2657	1.88	34.683	3.19	2.40	144	0.00	36		
3008	1.82	34.691	3.24	2.35	148	0.00	35		
3351	1.78	34.693	3.34	2.38	137	0.00	34		
3705	1.76	34.698	3.58	2.38	142	0.00	34		
4058	1.72	34.698	3.69	2.35	137	0.00	33		
4424	1.72	34.697	3.70	2.35	137	0.00	33		
4762	1.76	34.700	3.74	2.33	137	0.00	34		
5102	1.80	34.702	3.73	2.30	137	0.00	34		
5441	1.85f)	34.713	3.71	2.30	137	0.00	34		
5780	1.90g)	34.705	3.73	2.25	137	0.00	34		
6120	1.91	34.701	3.73	2.20	137	0.00	34		

- a) Alternate value, 19.76°C.
- b) Average of 14.26 and 14.30°C.
- c) Average of 34.871 and 34.879‰.
- d) Average of 2.13 and 2.17°C.
- e) One sample only.
- f) Average of 1.83 and 1.87°C.
- g) Average of 1.87 and 1.92°C.

SIO

STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

48

HORIZON; November 11, 1960; 1320 GCT; 21°16'S, 71°09'W; sounding, 3430 fm; wind, 253°, force 8 kt; weather, overcast; sea, missing; wire angle, 04°.

0	18.99	34.931	5.50	0.51	4	0.02	297	0	0.000
10	18.97	34.922	5.50	0.52	8	0.00	298	10	0.030
29	15.77	34.744	5.63	0.99	5	0.11	237	20	0.059
39	15.66	34.801	5.37	0.86	5	0.22	231	30	0.085
59	14.22	34.658	3.92	1.29	5	0.32	212	50	0.130
79	12.80	34.644	1.84a)	2.23	17	0.03	185	75	0.182
148	12.32	34.853b)	0.16	2.60	33	4.66	161	100	0.227
218	11.64	34.829	0.16	2.65	34	3.69	150	150	0.310
267	11.04	34.781	0.11	2.69	34	0.81	143	200	0.388
325	10.18	34.724	0.14	2.68	33	0.00	132	250	0.463
433	8.36	34.602	0.33	2.69	39	0.00	114	300	0.534
539	6.97	34.522	1.01	2.69	41	0.00	100	400	0.662
647	5.98	34.467	1.42	2.80	48	0.00	91	500	0.773
754	5.40	34.481	1.29	2.82	61	0.00	84	600	0.873
859	4.88	34.493	1.33	2.81	69	0.00	78	700	0.964
1070	4.03	34.522	1.76	2.76	90	0.00	67	800	1.048
1323	3.30	34.562	2.07	2.69	110	0.00	57	1000	1.199
1578	2.74	34.599	2.49	2.60	122	0.00	48		
1841	2.37	34.628	2.64	2.52	135	0.00	43		
2134	2.11	34.650	2.97	2.46	138	0.00	40		

49

HORIZON; November 17, 1960; 1336 GCT; 23°41'S, 70°38'W; sounding, 750 fm; wind, 155°, force 7 kt; weather, partly cloudy; sea, rough; wire angle, 05°.

0	17.39c)	34.746	5.82	0.58	10	0.05	273	0	0.000
10	16.70	34.724	5.03	0.82	21	0.11	260	10	0.027
20	14.58	34.669	2.24	2.00	28	0.63	218	20	0.051
29	12.86	34.712	0.65	2.56	38	0.52	181	30	0.070
39	12.48	34.742	0.23	2.85	42	0.09	172	50	0.105
49	12.37	34.779	0.11	2.90	48	0.03	166	75	0.146
79	12.20	34.829	0.12	2.91	59	3.69	160	100	0.185
124	11.83d)	34.825	0.13	2.75	54	3.82	154	150	0.262
162	11.47	34.802	0.10	2.83	50	0.71	149	200	0.336
202	11.14	34.794	0.14	2.85	50	0.15	144	250	0.406
251	10.54	34.742	0.14	2.85	50	0.00	138	300	0.474
304	9.98	34.714	0.14	2.88	53	0.00	130	400	0.598
401	8.72	34.626	0.31	2.85	56	0.00	118	500	0.709
498	7.17	34.512	1.25	2.55	55	0.00	104	600	0.807
598	5.94	34.441	2.01	2.83	58	0.00	94	700	0.896
696	5.33	34.471	1.77	2.85	57	0.00	84	800	0.976
798	4.81	34.490	1.75	2.85	96	0.00	77	1000	1.121
896	4.50	34.502	1.71	3.06	107	0.00	73		
998	4.25	34.535	1.77	2.88	121	0.00	68		
1199	3.58	34.553	2.03	2.76	143	0.00	60		

a) Poor sample, probably high.

b) Alternate value, 34.861‰.

c) Alternate value, 18.06°C.

d) Alternate value, 12.38°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; November 17-18, 1960; 0253, 2119 GCT; 23°38'S, 71°27'W; sounding, 3950 fm; wind, 195°, force 4 kt; weather, overcast; sea, missing; wire angle, 05°, 23°.

0	17.65a)	34.808	5.71	0.59	4	0.05	275	0	0.000
10	17.26	34.814	5.69	0.60	7	0.05	266	10	0.027
29	16.84	34.830	5.66	0.60	5	0.06	255	20	0.053
55	12.82	34.485	2.83	1.78	10	0.19	197	30	0.079
75	11.80	34.436	2.01	1.98	14	0.02	182	50	0.125
104	11.72	34.647	0.61	2.30	26	0.02	164	75	0.173
158	11.40	34.761	0.21	2.43	33	0.00	151	100	0.216
217	10.62	34.731	0.18	2.40	34	0.00	140	150	0.296
266	10.06	34.698	0.18	2.40	34	0.00	133	200	0.370
325	9.25	34.638	0.29	2.45	35	0.00	124	250	0.440
432	7.75	34.545	0.85	2.48	35	0.00	109	300	0.505
537	6.34	34.465	1.76	2.48	39	0.00	96	400	0.626
642	5.91	34.462	1.78	2.48	44	0.00	92	500	0.733
747	5.33	34.472	1.59	2.48	56	0.00	84	600	0.830
852	4.72	34.478	1.76	2.50	66	0.00	76	700	0.921
1062	3.98	34.519	-	2.59	87	0.00	66	800	1.004
1317	3.34	34.573	2.17	2.60	105	0.00	56	1000	1.153
1574	2.78	34.599	2.49	2.38	119	0.00	49		
1846	2.42	34.632	2.83	2.31	126	0.00	44		
2128	2.15	34.660	3.04	2.31	132	0.00	40		
2261	2.05	34.677	3.18	2.32	137	0.00	37		
2540	1.92	34.689	3.14	2.37	139	0.00	36		
2820	1.84	34.697	3.20	2.46	145	0.00	34		
3192	1.80	34.704	3.24	2.36	145	0.00	34		
3567	1.81b)	34.696	3.38	2.30	145	0.00	34		
3942	1.80	34.702	3.59	2.34	135	0.00	34		
4368	1.77	34.705	3.70	2.37	135	0.00	34		
4754	1.78	34.702	3.72	2.42	135	0.00	34		
5138	1.80b)	34.704	3.72	2.38	137	0.00	34		
5573	1.86	34.706	3.72	2.38	137	0.00	34		
5963	1.90c)	34.702	3.73	2.33	138	0.00	34		
6450	1.97	34.703	3.76	2.30	138	0.00	35		

HORIZON; November 18, 1960; 0920 GCT; 23°48'S, 72°00'W; sounding, 2400 fm; wind, direction missing, force 3 kt; weather, overcast; sea, missing; wire angle, 06°.

0	17.55d)	34.764	5.60	0.73	5	0.05	275	0	0.000
10	17.24	34.764	5.67	0.71	7	0.05	269	10	0.027
20	17.04	34.775e)	5.72	0.70	5	0.04	263	20	0.054
29	14.80	34.638	5.01	1.13	4	0.29	225	30	0.078
49	13.04	34.579	2.11	2.28	10	0.17	194	50	0.120
78	12.00	34.614	0.68	2.63	21	0.02	172	75	0.165
108	11.84	(34.715)	0.31	2.74	27	0.00	(162)	100	0.208
142	11.62	34.772	0.20	2.75	32	0.00	154	150	0.287
171	11.24	34.756	0.13	2.88	32	0.00	148	200	0.360
200	10.84	34.748	0.14	2.88	32	0.00	142	250	0.428
220	10.18	34.708	0.24	2.86	33	0.00	134	300	0.493
301	9.53	34.671	0.25	2.87	34	0.00	126	400	0.612
396	8.04	34.563	0.70	2.88	34	0.00	112	500	0.719
493	6.90	34.484	1.55	2.83	35	0.00	102	600	0.816
594	6.00	34.451	1.89	2.86	40	0.00	94	700	0.906
690	5.41f)	34.442	1.89	2.87	49	0.00	87	800	0.989
792	4.92	34.468	1.69	3.10	62	0.00	80	1000	1.135
889	4.53	34.485	1.77	3.08	70	0.00	74		
990	4.12g)	34.511	1.87	2.98	83	0.00	68		
1189	3.58	34.549	2.00	2.98	98	0.00	60		

- a) One thermometer only.
- b) Alternate value, 1.85°C.
- c) Alternate value, 1.97°C.
- d) Alternate value, 17.70°C.
- e) Alternate value, 34.782‰.
- f) Average of 5.39 and 5.43°C.
- g) One value only.

S10
STEP-1

50

51

27

SIO
STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ _T	Z	ΔD'
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

52

HORIZON; November 18, 1960; 1557 GCT; 23°54'S, 72°37'W; sounding, 2240 fm; wind, 195°, force 6 kt; weather, overcast; sea, missing; wire angle, 08°.

0	16.26	34.576	5.77	0.64	3	0.05	260	0	0.000
25	16.00	34.561	5.65	0.70	6	0.09	256	10	0.026
44	15.22	34.615	5.45	0.79	4	0.24	235	20	0.052
64	14.42	34.517	5.28	0.88	4	0.99	226	30	0.077
88	13.00a)	34.350	4.36	1.19	4	trace	210	50	0.126
108	11.88	34.342	2.93	1.74	9	0.00	190	75	0.182
132	12.04	34.614	0.80	2.45	21	0.00	173	100	0.235
151	11.98b)	34.712	0.38	2.60	30	0.00	165	150	0.326
185	11.49	34.761	0.23	2.60	32	0.00	153	200	0.404
215	11.29	34.774	0.14	2.60	33	0.00	148	250	0.477
263	10.32	34.703	0.23	2.60	33	0.00	137	300	0.544
320	9.54	34.676	0.24	2.59	34	0.00	126	400	0.666
426	7.71	34.534	0.95	2.60	35	0.00	110	500	0.773
530	6.37c)	34.439	2.19	2.61	35	0.00	99	600	0.870
636	5.71	34.450	1.78	2.65	45	0.00	90	700	0.959
741	5.24	34.459	1.74	2.73	55	0.00	84	800	1.042
848	4.68	34.481	1.76	2.83	68	0.00	76	1000	1.190
954	4.22	34.498	1.87	2.88	79	0.00	70		
1061	3.85	34.519	2.08	2.80	88	0.00	65		
1272	3.32	34.563	2.20	2.78	102	0.00	57		

53

HORIZON; November 19, 1960; 0233 GCT; 23°41'S, 73°43'W; sounding, 1895 fm; wind, 150°, force 9 kt; weather, overcast; sea, missing; wire angle, 13°.

0	16.25d)	34.569	5.69	0.62	6	0.05	260	0	0.000
10	16.25	34.566	5.59	0.62	6	0.05	261	10	0.026
28	16.01e)	34.561	5.63	0.62	5	0.05	256	20	0.052
48	15.06	34.478f)	5.63	0.77	3	0.13	242	30	0.078
95	13.20g)	34.286	5.08	1.18	3	trace	219	50	0.127
129	12.04	34.419	2.41	2.09	12	0.00	188	75	0.186
168	11.46	34.589	0.95	2.58	23	0.00	164	100	0.242
176	11.48	34.640	0.72	2.76	24	0.00	161	150	0.339
195	11.00	34.633	0.64	2.80	28	0.00	154	200	0.420
241	10.36	34.658	0.42	2.83	29	0.00	141	250	0.492
291	9.52	34.644	0.30	2.88	33	0.00	128	300	0.558
383	7.98	34.535	0.87	2.85	33	0.00	113	400	0.677
478	6.64	34.448	2.05	2.88	32	0.00	101	500	0.782
577	5.87	34.423	2.34	2.87	36	0.00	94	600	0.878
672	5.46	34.444	1.98	2.90	47	0.00	88	700	0.967
772	4.94	34.457	1.86	2.90	59	0.00	80	800	1.049
867	4.48	34.478h)	2.00	2.90	67	0.00	74	1000	1.194
968	4.18	34.505	1.91	2.88	78	0.00	69		
1168	3.60	34.538	2.13	2.86	95	0.00	61		

- a) Average of 13.04 and 12.97°C.
- b) Average of 12.00 and 11.96°C.
- c) Average of 6.35 and 6.39°C.
- d) Alternate value, 16.31°C.
- e) Alternate value, 15.24°C.
- f) Alternate value, 34.487‰.
- g) Average of 13.22 and 13.18°C.
- h) Alternate value, 34.471‰.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; November 19, 1960; 1150 GCT; 23°42'S, 74°56'W; sounding, 2440 fm; wind, 144°, force 16 kt; weather, overcast; sea, missing; wire angle, 21°.

0	16.71	34.592	5.57	0.36	3	0.00	269	0	0.000
23	16.72	34.589	5.45	0.59	3	0.00	269	10	0.027
42	16.03	34.573	5.54	0.67	2	0.03	256	20	0.054
61	15.30	34.543	5.41	0.77	2	0.59	242	30	0.081
83	14.99a)	34.576	5.24	0.83	1	0.53	233	50	0.133
101	13.34	34.304	5.01	1.18	2	trace	220	75	0.193
124	12.45	34.241	4.60	1.48	4	0.00	208	100	0.250
143	11.76b)	34.264	3.91	1.78	7	0.00	193	150	0.352
174	10.92	34.419	1.87	2.16	16	0.00	168	200	0.438
202	10.85	34.597	0.73	2.61	26	0.00	154	250	0.511
247	10.31	34.649	0.40	2.69	30	0.00	140	300	0.579
301	9.50	34.607	0.48	2.77	30	0.00	130	400	0.701
401	8.04	34.539	0.86	2.79	31	0.00	114	500	0.810
501	6.80	34.462	1.79	2.80	33	0.00	103	600	0.910
602	6.08	34.439	1.97	2.78	38	0.00	96	700	1.001
703	5.34	34.430	2.10	2.78	48	0.00	87	800	1.085
804	4.85	34.459	1.85	2.95	60	0.00	80	1000	1.233
907	4.44	34.488	1.74	2.93	74	0.00	73		
1008	4.08	34.512	1.93	2.90	82	0.00	68		
1212	3.50	34.544	2.20	2.80	98	0.00	60		

HORIZON; November 19-20, 1960; 0230, 2315 GCT; 23°41'S, 75°56'W; sounding, 2345 fm; wind, 150°, force 18 kt; weather, overcast; sea, missing; wire angle, 25°, 35°.

0	16.74	34.596	5.55	0.38	5	0.01	270	0	0.000
9	16.74	34.601	5.50	0.36	5	0.01	269	10	0.027
31	16.72	34.604	5.56	0.36	5	0.01	268	20	0.054
54	16.40	34.580	5.58	0.39	3	0.01	263	30	0.081
62	15.48	34.498	5.62	0.52	2	0.08	250	50	0.134
88	15.16	34.611	5.23	0.67	3	0.72	234	75	0.197
117	13.08	34.273	4.97	0.95	3	0.01	218	100	0.256
150	11.94	34.351	2.96	1.69	9	0.00	189	150	0.360
184	11.04	34.448	1.74	2.25	17	0.00	168	200	0.447
209	10.74	34.585	0.85	2.41	24	0.00	152	250	0.521
260	9.88	34.637	0.50	2.65	29	0.00	134	300	0.587
311	9.26	34.600	0.54	2.66	31	0.00	127	400	0.708
417	7.66	34.519	1.20	2.65	32	0.00	110	500	0.814
514	6.53	34.462	1.91	2.65	35	0.00	99	600	0.912
612	5.96	34.449	1.84	2.73	42	0.00	93	700	1.001
711	5.20	34.446	2.07	2.68	51	0.00	84	800	1.083
814	4.73	34.474	1.89	2.71	62	0.00	77	1000	1.228
902	4.40	34.489	1.82	2.81	73	0.00	73		
1014	4.06	34.517	1.84	2.84	85	0.00	67		
1229	3.46	34.552	2.22	2.78	99	0.00	59		
990	4.30	34.501	1.91	2.80	76	0.00	71		
1242	3.44	34.554	2.19	2.79	97	0.00	59		
1535	2.83	34.596	2.59	2.67	113	0.00	50		
1819	2.40	34.623	2.96	2.61	122	0.00	44		
2127	2.11	34.641	3.26	2.46	125	0.00	41		
2447	1.92	34.667	3.37	2.46	130	0.00	37		
2774	1.85c)	34.676	3.51	2.45	133	0.00	36		
3049	1.80	34.686	3.53	2.43	133	0.00	34		
3326	1.76	34.695	3.58	2.45	132	0.00	34		
3608	1.75	34.696	3.65	2.33	133	0.00	34		
3899	1.76	34.691	3.64	2.33	133	0.00	34		

a) Average of 15.01 and 14.97°C.

b) Average of 11.78 and 11.74°C.

c) Average of 1.83 and 1.87°C.

SIO
STEP-I

54

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SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁵ cm ³ /g	m	dyn m

56

HORIZON; November 20, 1960; 1107 GCT; 23°38'S, 77°06'W; sounding, 2470 fm; wind, 125°, force 11 kt; weather, overcast; sea, missing; wire angle, 19°.

0	17.08	34.758	5.33	0.40	3	0.00	266	0	0.000
23	17.08	34.743	5.50	0.58	9	0.00	266	10	0.027
41	17.10	34.760	5.50	0.65	3	0.00	266	20	0.053
66	16.68	34.787	5.55	0.38	3	0.00	254	30	0.080
93	15.98	34.671	5.39	0.59	2	0.34	247	50	0.133
112	15.82	34.729	5.16	0.61	3	0.72	240	75	0.197
140	13.64	34.397	4.64	1.03	5	trace	219	100	0.259
159	12.44	34.295	3.89	1.66	9	trace	204	150	0.373
196	11.15a)	34.366	2.46	2.03	14	0.00	176	200	0.469
223	10.96	34.518	1.52	2.29	21	0.00	160	250	0.550
278	10.00	34.597	0.74	2.73	27	0.00	139	300	0.621
332	8.98	34.561	0.83	2.72	31	0.00	126	400	0.744
445	7.22	34.470	1.75	2.71	31	0.00	108	500	0.852
548	6.08	34.396	2.87	2.72	31	0.00	98	600	0.951
651	5.62	34.415	2.45	2.85	39	0.00	92	700	1.043
755	5.07	34.449	2.01	2.85	55	0.00	83	800	1.126
865	4.58	34.472	1.94	2.92	69	0.00	75	1000	1.274
957	4.22	34.494	1.97	2.92	77	0.00	70		
1073	3.84	34.527	2.12	2.84	90	0.00	64		
1291	3.28	34.560	2.42	2.82	102	0.00	56		

57

HORIZON; November 20, 1960; 2353 GCT; 23°39'S, 78°55'W; sounding, 2480 fm; wind, 135°, force 13 kt; weather, overcast; sea, missing; wire angle, 13°.

0	17.56	34.882	5.46	0.40	3	trace	267	0	0.000
10	17.56	34.876	5.39	0.41	5	0.00	268	10	0.027
34	17.48	34.875	5.47	0.40	3	0.00	266	20	0.054
58	16.56	34.828	5.50	0.51	2	0.04	248	30	0.080
87	15.56	34.697	5.11	0.70	1	0.73	236	50	0.132
116	12.82	34.386	3.76	1.32	5	0.02	204	75	0.195
154	11.98	34.583	0.98	2.35	19	0.00	174	100	0.253
175	12.21	34.734	0.29	2.59	27	0.00	168	150	0.352
202	11.94	34.779	0.20	2.64	30	0.00	159	200	0.436
231	11.64	34.785	0.17	2.66	31	0.00	154	250	0.513
289	10.84	34.741	0.17	2.64	31	0.00	143	300	0.586
347	10.25	34.720	0.17	2.64	33	0.00	134	400	0.720
468	8.59	34.611	0.35	2.65	35	0.00	116	500	0.839
578	7.12	34.517	1.11	2.65	37	0.00	102	600	0.945
688	6.10	34.472	1.57	2.66	42	0.00	93	700	1.041
798	5.36	34.458	1.71	2.75	52	0.00	85	800	1.130
914	4.84	34.472	1.67	2.79	64	0.00	78	1000	1.288
1133	3.99	34.512	2.05	2.71	84	0.00	67		
1358	3.40	34.543	2.39	2.68	99	0.00	59		

a) Average of 11.17 and 11.13°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; November 21, 1960; 1215, 1410 GCT; 23°41'S, 80°42'W; sounding, 2230 fm; wind, 120°, force 7 kt; weather, overcast; sea, missing; wire angle, 10°, 29°.

0	17.68	34.927	5.42	0.48	2	0.00	266	0	0.000
25	17.70	34.909	5.44	0.48	5	0.00	268	10	0.027
45	17.60	34.932	5.46	0.45	2	trace	265	20	0.054
70	16.19	34.786	5.46	0.60	2	0.11	244	30	0.080
98	15.61	34.740	5.12	0.79	1	0.95	234	50	0.133
117	14.60	34.618	4.55	1.04	3	0.02	222	75	0.196
145	12.08	34.338	3.36	1.58	7	trace	194	100	0.256
165	11.54	34.392	2.53	1.98	11	0.00	180	150	0.362
202	10.88	34.516	1.42	2.35	20	0.00	160	200	0.450
231	10.50	34.589	0.90	2.54	24	0.00	148	250	0.526
288	9.30	34.536	1.17	2.63	24	0.00	133	300	0.594
345	8.52	34.532	1.11	2.68	27	0.00	122	400	0.715
459	7.08	34.481	1.52	2.74	32	0.00	105	500	0.822
572	6.23	34.460	1.61	2.84	40	0.00	96	600	0.919
680	5.55	34.441	1.84	2.85	46	0.00	89	700	1.010
789	5.05	34.486	1.69	2.93	59	0.00	80	800	1.093
903	4.50	34.486	1.86	2.93	69	0.00	74	1000	1.242
999	4.20	34.504	1.86	2.93	79	0.00	70		
1118	3.88	34.527	2.08	2.88	88	0.00	64		
1340	3.29	34.556	2.46	2.76	98	0.00	57		
924	4.52	34.497	1.77	2.89	72	0.00	73		
1214	3.64	34.546	2.21	2.77	92	0.00	61		
1519	2.93	34.584	2.70	2.61	108	0.00	52		
1816	2.48	34.620	3.07	2.54	114	0.00	46		
2132	2.11	34.649	3.42	2.48	122	0.00	40		
2459	1.90	34.672	3.58	2.47	128	0.00	37		
2796	1.84	34.680	3.72	2.46	128	0.00	36		
3076	1.79	34.693	3.71	2.48	128	0.00	34		
3357	1.74	34.693	3.75	2.45	128	0.00	34		
3643	1.74	34.697	3.73	2.35	131	0.00	34		
3932	1.75	34.690	3.75	2.40	131	0.00	34		

HORIZON; November 22, 1960; 0446 GCT; 23°43'S, 82°37'W; sounding, 1850 fm; wind, 135°, force 13 kt; weather, overcast; sea, missing; wire angle, 18°.

0	17.93	34.794	5.22	0.41	3	0.00	282	0	0.000
9	17.94	34.787	5.39	0.44	5	0.00	282	10	0.028
31	17.86	34.783	5.42	0.38	3	0.00	282	20	0.056
59	16.67	34.722	5.61	0.38	3	0.00	259	30	0.085
81	16.28	34.708	5.36	0.50	2	0.43	251	50	0.140
114	15.42	34.574	5.14	0.67	2	0.33	242	75	0.205
132	13.85a)	34.365	4.86	0.92	3	trace	226	100	0.267
151	12.16	34.212	4.10	1.39	7	trace	205	150	0.381
182	11.32	34.283	3.10	1.87	10	0.00	185	200	0.475
200	11.07	34.387	2.39	2.05	15	0.00	172	250	0.555
245	10.16	34.531	1.25	2.51	24	0.00	146	300	0.624
299	9.48	34.565	0.83	2.64	29	0.00	133	400	0.746
399	7.54	34.479	1.46	2.65	29	0.00	111	500	0.853
497	6.71	34.428	2.28	2.70	29	0.00	104	600	0.952
596	5.91	34.397	2.60	-	33	0.00	96	700	1.043
696	5.34b)	34.430	2.26	2.90	46	0.00	87	800	1.126
797	4.76	34.450	2.03	2.90	62	0.00	79	1000	1.273
898	4.24	34.483	2.09	2.95	74	0.00	72		
1000	3.98	34.503	2.18	2.90	83	0.00	68		
1206	3.45	34.538	2.41	2.80	97	0.00	60		

a) Alternate value, 13.30°C.

b) Average of 5.32 and 5.36°C.

COLUMBIA UNIVERSITY
HUDSON LABORATORIES
CONTRACT NON-266(84)

SIO

STEP-1

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SIO

STEP - I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$\mu\text{g at/L}$	$10^5 \text{ cm}^3/\text{g}$	m	dyn m

60

HORIZON; November 22, 1960; 1750 GCT; 23°43'S, 84°14'W; sounding, 1648 fm; wind, 120°, force 9 kt; weather, cloudy; sea, missing; wire angle, 06°.

0	18.18	34.827	5.38	0.44	4	0.00	285	0	0.000
25	18.04	34.811	5.23	0.42	5	0.00	284	10	0.029
44	17.62	34.900	5.46	0.41	3	0.00	268	20	0.057
54	17.57	34.906	5.46	0.38	2	0.00	266	30	0.085
89	17.14	34.831	5.46	0.41	1	trace	261	50	0.140
124	17.11	34.871	5.30	0.44	2	0.09	258	75	0.207
163	16.52	34.773	5.15	0.56	2	0.31	252	100	0.272
172	14.86	34.481	5.02	0.73	2	0.02	238	150	0.401
196	13.68	34.334	4.81	0.96	2	trace	224	200	0.520
216	12.74	34.271	4.53	1.16	3	0.00	211	250	0.620
263	10.99	34.408	2.63	2.10	13	0.00	170	300	0.703
321	9.92a)	34.528	1.36	2.58	23	0.00	143	400	0.838
424	7.85	34.475	1.78	2.73	24	0.00	116	500	0.950
528	6.31	34.403	3.01	2.63	26	0.00	101	600	1.051
633	5.66	34.385	2.95	2.73	33	0.00	94	700	1.143
737	5.02	34.421	2.52	3.04	51	0.00	85	800	1.227
842	4.53	34.458	2.33	2.96	63	0.00	76	1000	1.374
949	4.06	34.493	2.33	2.94	75	0.00	69		
1055	3.82	34.521	2.37	2.95	84	0.00	65		
1264	3.29	34.548	2.69	2.81	96	0.00	57		

61

HORIZON; November 23, 1960; 1133, 0628 GCT; 23°41'S, 86°09'W; sounding, 2040 fm; wind, 080°, force 9 kt; weather, overcast; sea, missing; wire angle, missing, 40°.

0	18.40b)	35.178	5.32	0.45	2	0.00	265	0	0.000
10	18.42	35.177	5.35	0.46	5	0.00	266	10	0.027
33	18.38	35.179	5.34	0.47	4	0.00	264	20	0.053
76	17.86	35.097	5.25	0.43	1	0.00	258	30	0.080
105	17.40	35.010	5.21	0.47	1	0.13	254	50	0.132
128	17.12	34.992	5.15	0.49	2	0.30	250	75	0.198
158	16.45	34.887	4.93	0.66	3	0.24	242	100	0.262
180	14.77	34.625	4.65	0.86	6	0.02	225	150	0.387
199	13.56	34.469	4.27	1.11	6	0.00	212	200	0.501
209	13.18	34.437	4.19	1.18	6	0.00	207	250	0.596
255	11.27	34.476	2.24	2.08	15	0.00	170	300	0.678
312	10.56	34.604	0.93	2.54	18	0.00	148	400	0.817
414	8.82	34.540	1.07	2.65	29	0.00	125	500	0.936
515	7.40	34.498	1.45	2.65	31	0.00	108	600	1.041
618	6.24	34.426	2.23	2.64	33	0.00	98	700	1.137
722	5.61c)	34.433	2.12	2.76	44	0.00	90	800	1.226
825	5.20	34.451	1.86	2.87	54	0.00	84	1000	1.384
930	4.46	34.463	2.24	2.79	64	0.00	75		
1034	4.08	34.492	2.36	2.76	77	0.00	70		
1244	3.52d)	(34.535)	2.58	2.75	92	0.00	(60)		
913	4.59	34.462	2.23	2.74	62	0.00	77		
1204	3.56	34.531	2.53	2.71	91	0.00	61		
1504	2.88	34.578	2.87	2.54	104	0.00	52		
1797	2.40	34.614	3.22	2.49	116	0.00	45		
2110	2.08	34.649	3.43	2.46	126	0.00	40		
2437	1.89	-	3.56	2.45	131	0.00	-		
2776	1.82	34.676	3.60	2.40	133	0.00	36		
3065	1.82	34.679	3.56	2.42	136	0.00	36		

a) Average of 9.90 and 9.94°C.

b) Average of 18.42 and 18.38°C.

c) Average of 5.59 and 5.63°C.

d) Average of 3.50 and 3.54°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; November 23, 1960; 2121 GCT; 23°40'S, 87°51'W; sounding, 2040 fm; wind, 110°, force 10 kt; weather, cloudy; sea, missing; wire angle, 11°.

62

0	18.98	35.118	5.25	0.34	3	0.00	284	0	0.000
26	18.86	35.116	5.31	0.34	3	0.00	281	10	0.028
54	18.02	35.010	5.44	0.38	2	0.00	269	20	0.056
87	17.66	34.966	5.45	0.35	1	0.00	264	30	0.085
108	17.75	35.041	5.37	0.38	1	0.00	260	50	0.140
131	17.72	35.037	5.28	0.38	1	0.00	259	75	0.207
163	17.62	35.021	5.19	0.43	1	0.22	258	100	0.272
171	16.51	34.788	5.13	0.51	2	0.20	250	150	0.402
195	14.62	34.512	4.84	0.81	3	trace	230	200	0.524
214	13.50	34.374	4.62	0.96	3	0.00	218	250	0.628
261	11.34	34.336	4.19	1.40	4	0.00	181	300	0.715
317	9.90	34.419	3.01	1.92	12	0.00	151	400	0.854
421	7.58	34.437	2.39	2.34	21	0.00	114	500	0.965
523	6.12	34.371	3.56	2.34	22	0.00	101	600	1.064
626	5.58	34.388	2.82	2.54	34	0.00	93	700	1.155
728	5.04	34.402	2.73	2.69	45	0.00	86	800	1.239
832	4.49	34.439	2.64	2.70	59	0.00	78	1000	1.385
934	4.06	34.477	2.57	2.72	72	0.00	70		
1040	3.72	34.522	2.64	2.72	83	0.00	64		
1246	3.30	34.551	2.62	2.72	99	0.00	57		

HORIZON; November 24, 1960; 0953, 1202 GCT; 23°41'S, 89°37'W; sounding, 2030 fm; wind, 145°, force 10 kt; weather, overcast; sea, missing; wire angle, 15°, 33°.

63

0	19.42	35.328	5.18	0.36	3	0.00	280	0	0.000
10	19.43	35.327	5.12	0.36	6	0.00	280	10	0.028
34	19.40	35.321	5.22	0.37	5	0.00	280	20	0.056
63	18.68	35.272	5.33	0.39	3	0.00	266	30	0.084
86	18.74	35.327	5.27	0.36	2	0.00	263	50	0.139
120	18.64	35.325	5.20	0.37	3	trace	261	75	0.206
148	18.60	35.313	5.16	0.41	4	0.09	261	100	0.272
167	18.48	35.283	5.15	0.43	4	0.09	260	150	0.402
199	18.38	35.253	5.13	0.43	4	0.15	260	200	0.532
209	17.53	35.099	5.00	0.52	3	0.18	251	250	0.650
256	13.16	34.453	4.41	1.05	4	0.00	206	300	0.745
312	10.64	34.454	2.40	2.10	18	0.00	160	400	0.893
415	8.69	34.518	1.37	2.55	28	0.00	125	500	1.012
516	6.96	34.420	2.47	2.43	28	0.00	108	600	1.116
620	5.86	34.374	3.07	2.45	30	0.00	97	700	1.211
722	5.34	34.404	2.63	2.63	46	0.00	89	800	1.298
826	4.80	34.430	2.42	2.79	57	0.00	82	1000	1.452
930	4.34	34.469	2.29	2.85	71	0.00	73		
1035	4.06	34.495	2.39	2.83	81	0.00	69		
1241	3.48	34.533	2.59	2.80	96	0.00	60		
1022	4.14	34.481	2.39	2.75	77	0.00	71		
1308	3.35	34.539	2.66	2.70	100	0.00	58		
1623	2.68	34.588	3.13	2.57	113	0.00	49		
1918	2.25	34.622	3.35	2.50	120	0.00	44		
2233	1.99	34.655	3.54	2.40	130	0.00	38		
2559	1.87	34.668	3.59	2.35	133	0.00	36		
2895	1.80	34.683	3.58	2.43	133	0.00	36		
3181	1.80	34.689	3.52	2.45	139	0.00	34		
3469	1.80	34.692	3.46	2.50	144	0.00	34		

SIO
STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn n

64

HORIZON; November 25, 1960; 0218 GCT; 23°41'S, 91°28'W; sounding, 1905 fm; wind, 105°, force 14 kt; weather, overcast; sea, missing; wire angle, 15°.

0	19.71	35.351	5.18	0.33	2	0.00	284	0	0.000
33	19.71	35.344	5.10	0.29	3	0.00	285	10	0.028
52	18.89	35.231	5.30	0.32	3	0.00	274	20	0.057
62	18.74	35.226	5.33	0.32	3	0.00	270	30	0.085
85	18.56a)	35.220	5.31	0.32	1	0.00	266	50	0.141
105	18.50b)	35.212	5.31	0.30	2	0.00	265	75	0.209
128	18.46	35.210	5.25	0.33	2	0.00	264	100	0.276
148	18.38	35.199	5.17	0.34	2	0.02	263	150	0.408
181	18.36c)	35.187	5.16	0.34	1	0.04	263	200	0.539
210	18.02d)	35.134	5.10	0.36	1	0.15	260	250	0.660
256	14.02	34.543	4.68	0.79	1	0.00	216	300	0.762
312	11.18	34.406	4.17	1.29	6	0.00	172	400	0.917
414	8.24	34.444	2.27	2.30	21	0.00	124	500	1.036
515	6.60	34.382	3.17	2.30	24	0.00	106	600	1.139
619	5.60	34.324	4.05	2.27	25	0.00	98	700	1.235
722	5.12	34.372	3.21	2.45	39	0.00	90	800	1.322
826	4.62	34.413	2.90	2.60	52	0.00	81	1000	1.474
930	4.22	34.459	2.55	2.74	68	0.00	73		
1034	3.94	34.500	2.57	2.79	81	0.00	67		
1241	3.42	34.539	2.71	2.66	95	0.00	60		

65

HORIZON; November 25, 1960; 1404 GCT; 23°41'S, 93°11'W; sounding, 2020 fm; wind, 105°, force 14 kt; weather, overcast; sea, missing; wire angle, 23°.

0	20.07	35.443	5.04	0.33	2	0.00	288	0	0.000
9	20.07	35.438	4.99	0.30	3	0.00	288	10	0.029
30	20.08	35.436	5.11	0.30	4	0.00	288	20	0.058
49	20.06	35.439	5.13	0.30	2	0.00	287	30	0.086
71	19.30	35.377	5.26	0.30	1	0.00	273	50	0.144
88	19.04	35.330	5.23	0.27	3	0.00	270	75	0.214
111	18.89	35.313	5.24	0.26	3	0.00	268	100	0.281
137	18.88	35.323	5.19	0.28	3	trace	267	150	0.415
176	18.30e)	35.235	5.01	0.38	3	0.10	259	200	0.542
194	16.92	34.978	4.85	0.54	1	0.06	246	250	0.650
237	13.46	34.529	4.66	0.83	3	trace	206	300	0.740
289	10.99	34.399	4.31	1.24	4	0.00	170	400	0.883
386	8.14	34.385	3.10	2.04	14	0.00	126	500	0.998
482	6.60	34.348	3.88	2.03	18	0.00	108	600	1.100
580	5.64	34.295	4.78	1.97	15	0.00	101	700	1.195
677	5.38f)	34.361	3.44	2.37	33	0.00	93	800	1.282
773	4.86	34.388	2.94	2.55	45	0.00	85	1000	1.435
872	4.41	34.435	2.61	2.72	61	0.00	77		
972	4.15	34.471	2.51	2.64	72	0.00	72		
1176	3.58	34.517	2.76	2.58	90	0.00	62		

- a) Average of 18.58 and 18.54°C.
- b) Average of 18.48 and 18.52°C.
- c) Average of 18.38 and 18.33°C.
- d) Alternate value, 16.51°C.
- e) Average of 18.32 and 18.28°C.
- f) Average of 5.36 and 5.40°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; November 26, 1960; 0854, 0620 GCT; 23°40'S, 95°13'W; sounding, 1725 fm; wind, 055°, force 9 kt; weather, clear; sea, missing; wire angle, 09°, 17°.

66

0	20.42a)	35.482	5.07	0.29	7	0.00	294	0	0.000
26	20.41	35.488	5.02	0.31	14	0.00	292	10	0.029
45	19.97	35.426	5.17	0.25	12	0.00	286	20	0.059
54	19.56	35.389	5.22	0.25	8	0.00	278	30	0.088
64	19.48	35.381	5.25	0.25	5	0.00	277	50	0.145
98	19.36	35.448	5.19	0.24	7	0.00	268	75	0.214
131	19.12	35.386	5.17	0.24	10	0.00	268	100	0.282
170	18.98	35.364	5.13	0.25	11	0.00	266	150	0.416
213	15.96	34.816	4.73	0.55	7	0.00	236	200	0.546
241	13.84	34.573	4.43	0.80	6	0.00	210	250	0.659
275	12.15	34.460	4.04	1.13	10	0.00	186	300	0.752
318	10.79	34.529	2.49	1.80	20	0.00	159	400	0.901
422	8.93	34.542	1.15	2.36	31	0.00	129	500	1.023
525	6.95	34.436	2.36	2.20	32	0.00	106	600	1.127
631	5.78	34.378	3.24	2.20	32	0.00	96	700	1.222
735	5.24	34.388	2.96	2.27	46	0.00	89	800	1.310
840	4.70	34.423	2.66	2.42	58	0.00	81	1000	1.464
944	4.35	34.466	2.46	2.49	68	0.00	74		
1049	3.98	34.507	2.57	2.49	84	0.00	67		
1256	3.52	34.547	2.72	2.38	98	0.00	60		
1038	4.04	34.499	2.54	2.43	78	0.00	68		
1322	3.29	34.556	2.78	2.39	103	0.00	57		
1605	2.70	34.600	3.03	2.31	110	0.00	48		
1890	2.26	34.635	3.38	2.28	122	0.00	42		
2174	2.00	34.661	3.53	2.25	129	0.00	38		
2459	1.89	34.678	3.57	2.25	130	0.00	36		
2744	1.86	34.684	3.59	2.27	136	0.00	36		
3037	1.84	34.689	3.56	2.26	142	0.00	35		

HORIZON; November 26, 1960; 2117 GCT; 21°47'S, 95°07'W; sounding, 2130 fm; wind, 148°, force 9 kt; weather, cloudy; sea, missing; wire angle, 12°.

67

0	20.89b)	35.601	5.10	0.43	8	0.00	297	0	0.000
10	20.46	35.589	5.01	0.30	15	0.00	286	10	0.029
54	20.28	35.584	5.14	0.31	11	0.00	282	20	0.058
87	19.81	35.600	5.23	0.34	7	0.00	270	30	0.086
106	19.58	35.592	5.18	0.34	4	0.00	264	50	0.143
140	19.64	35.634	5.05	0.36	7	0.06	263	75	0.213
169	19.64	35.659	5.03	0.41	9	0.14	261	100	0.280
193	19.60	35.663	4.96	0.46	11	0.32	260	150	0.412
213	19.28c)	35.576	4.90	0.52	8	0.41	258	200	0.542
241	16.88	35.063	4.64	0.58	6	0.03	239	250	0.665
270	14.66	34.709	4.41	0.81	6	0.00	217	300	0.770
317	11.38	34.453	3.64	1.34	14	0.00	173	400	0.929
422	8.50	34.478	1.87	2.20	26	0.00	125	500	1.050
525	6.58d)	34.381	3.35	2.09	28	0.00	106	600	1.153
630	5.69	34.361	3.52	2.11	29	0.00	96	700	1.248
733	5.22	34.409	2.74	2.39	48	0.00	88	800	1.334
838	4.80	34.460	2.20	2.57	64	0.00	79	1000	1.485
944	4.44	34.504	2.05	2.59	78	0.00	72		
1048	4.08	34.524	2.17	2.59	91	0.00	67		
1256	3.48	34.553	2.50	2.42	105	0.00	59		

a) Alternate value, 19.82°C.

b) Alternate value, 21.15°C.

c) Average of 19.30 and 19.26°C.

d) Average of 6.60 and 6.56°C.

S10

STEP-I

68

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; November 27, 1960; 1023, 1237 GCT; 19°55'S, 95°05'W; sounding, 2000+ fm; wind, 100°, force 9 kt; weather, missing; sea, missing; wire angle, 10°, 13°.

0	20.34	35.706	4.92	0.42	8	0.00	275	0	0.000
25	20.27	35.700	5.09	0.38	15	0.00	274	10	0.027
45	20.22	35.704	5.12	0.39	12	0.00	272	20	0.055
64	20.15	35.758	5.19	0.36	8	0.00	266	30	0.082
87	19.84	35.705	5.14	0.38	6	0.01	262	50	0.136
121	19.60	35.658	5.12	0.39	8	0.02	260	75	0.203
150	19.70a)	35.714	5.04	0.44	9	0.12	258	100	0.269
182	19.54	35.684	4.97	0.46	12	0.23	256	150	0.390
212	18.64b)	35.484	4.77	0.59	8	0.27	249	200	0.527
239	16.33	35.042	4.35	0.80	8	0.01	228	250	0.645
268	13.71	34.678	3.74	1.12	11	0.00	200	300	0.743
314	11.40	34.549	2.19	1.89	22	0.00	166	400	0.897
416	9.10	34.560	1.04	2.44	32	0.00	128	500	1.017
519	7.20	34.500	1.71	2.35	38	0.00	105	600	1.119
624	6.12	34.450	2.08	2.36	41	0.00	95	700	1.212
731	5.52c)	34.475	1.78	2.64	58	0.00	86	800	1.297
837	5.00	34.482	1.67	2.72	68	0.00	80	1000	1.449
943	4.56	34.494	1.74	2.65	78	0.00	74		
1050	4.14	34.529	1.95	2.64	92	0.00	67		
1259	3.43	34.558	2.31	2.46	111	0.00	58		
924	4.65d)	34.493	1.69	2.72	74	0.00	75		
1230	3.60	34.545	2.23	2.59	98	0.00	60		
1545	2.89	34.585	2.54	2.49	118	0.00	51		
1850	2.40	34.618	2.90	2.39	129	0.00	44		
2172	2.08	34.649	3.29	2.28	133	0.00	40		
2504	1.88	34.666	3.44	2.25	133	0.00	36		
2846	1.83	34.675	3.42	2.25	142	0.00	36		
3129	1.79	34.683e)	3.41	2.29	143	0.00	35		
3411	1.78	34.684	3.39	2.28	143	0.00	36		
3692	1.80	34.686	3.46	2.29	145	0.00	34		
3993	1.83	34.693	3.44	2.27	145	0.00	35		

69

HORIZON; November 28, 1960; 0113 GCT; 18°16'S, 95°05'W; sounding, 2150 fm; wind, 110°, force 6 kt; weather, partly cloudy; sea, missing; wire angle, 12°.

0	20.38	35.624	5.04	0.45	5	0.00	282	0	0.000
10	20.14	35.608	5.12	0.42	6	0.00	277	10	0.028
35	19.98	35.671	5.21	0.40	5	0.00	268	20	0.055
64	19.64	35.663	5.11	0.40	3	0.06	261	30	0.083
97	19.44	35.639	5.02	0.45	1	0.14	258	50	0.136
131	19.40	35.640	4.95	0.47	2	0.40	256	75	0.201
160	18.26	35.391	4.84	0.56	2	0.29	247	100	0.266
183	16.74	35.102	4.44	0.74	4	0.01	233	150	0.394
213	14.58	34.768	4.08	1.00	4	0.00	210	200	0.512
241	13.18	34.635	3.44	1.29	6	0.00	192	250	0.613
270	11.58	34.490	2.83	1.63	12	0.00	174	300	0.699
316	10.18	34.549	1.37	2.31	24	0.00	146	400	0.837
419	8.31	34.532	1.23	2.49	29	0.00	118	500	0.949
521	6.58	34.464	2.06	2.38	35	0.00	99	600	1.047
624	6.09	34.484	1.56	2.64	46	0.00	92	700	1.136
728	5.41	34.486	1.56	2.82	59	0.00	84	800	1.219
832	4.90	34.508	1.55	2.76	69	0.00	76	1000	1.367
938	4.48	34.516	1.74	2.76	77	0.00	72		
1046	4.13	34.531	1.84	2.77	89	0.00	67		
1158	3.84	34.544	1.98	2.77	94	0.00	63		

a) One value only.

b) Average of 18.67 and 18.61°C.

c) Average of 5.50 and 5.54°C.

d) Alternate value, 4.30°C.

e) Alternate value, 34.690‰.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm/g	m	dyn m

HORIZON; November 28, 1960; 1310 GCT; 16°48'S, 94°59'W; sounding, 2200 fm; wind, 114°, force 6 kt; weather, cloudy; sea, missing; wire angle, 14°.

70

0	20.53a)	35.793	5.11	0.59	3	0.04	274	0	0.000
34	20.46	35.780	5.13	0.56	4	0.04	273	10	0.027
63	20.00	35.777	5.15	0.48	3	0.03	261	20	0.055
95	19.80	35.777	5.10	0.55	3	0.05	256	30	0.082
129	19.61b)	35.767	4.97	0.61	1	0.17	252	50	0.136
148	19.38	35.692	4.90	0.60	2	0.39	252	75	0.202
167	17.48c)	35.300	4.35	0.81	2	0.07	236	100	0.266
190	14.33d)	34.848	2.59	1.57	9	0.00	200	150	0.393
210	13.30	34.747	1.61	2.04	15	0.00	187	200	0.504
237	12.33	34.724	0.54	2.44	22	0.00	170	250	0.593
266	11.83	34.772	-	2.57	30	0.00	158	300	0.671
312	11.02	34.760	0.18	2.57	32	0.00	144	400	0.808
416	9.22	34.662	0.37	2.59	34	0.00	122	500	0.925
519	7.75	34.564	0.78	2.66	38	0.00	108	600	1.030
622	6.72	34.512	1.01	2.69	44	0.00	98	700	1.125
725	5.98	34.508	1.02	2.89	54	0.00	89	800	1.212
829	5.31	34.508	1.11	2.90	66	0.00	81	1000	1.366
933	4.70	34.515	1.24	2.89	79	0.00	74		
1039	4.36	34.536	1.43	2.89	85	0.00	69		
1247	3.58	34.556	1.97	2.78	103	0.00	60		

HORIZON; November 28-29, 1960; 0238, 2349 GCT; 15°03'S, 95°04'W; sounding, 2050 fm; wind, 110°, force 8 kt; weather, cloudy; sea, missing; wire angle, 16°, 19°.

71

0	20.82	35.724	5.00	0.74	5	0.11	286	0	0.000
10	20.78	35.723	5.10	0.66	8	0.12	285	10	0.029
33	20.52e)	35.731	5.17	0.66	6	0.11	278	20	0.057
62	20.12	35.805	5.13	0.51	4	0.05	262	30	0.085
95	19.90	35.792	4.96	0.56	3	0.13	258	50	0.140
127	19.54	35.706	4.86	0.60	3	0.38	254	75	0.206
156	19.12	35.607	4.77	0.64	3	0.53	252	100	0.270
179	17.29	35.265	4.12	0.96	6	0.02	233	150	0.398
198	15.33f)	34.978	3.51	1.20	6	0.01	211	200	0.513
207	14.76	34.891	3.32	1.26	8	0.00	205	250	0.608
253	11.64	34.602	1.63	2.10	19	0.00	167	300	0.686
308	10.36	34.676	0.46	2.58	31	0.00	139	400	0.816
410	8.82	34.657	0.63	2.58	36	0.00	116	500	0.927
510	7.54	34.584	0.89	2.65	44	0.00	104	600	1.026
611	6.48	34.536	1.05	2.77	50	0.00	93	700	1.116
712	5.75g)	34.517	1.14	2.85	61	0.00	85	800	1.199
813	5.12	34.519	1.19	2.93	71	0.00	78	1000	1.346
915	4.68	34.525	1.29	2.90	80	0.00	73		
1018	4.24	34.539	1.63	2.90	92	0.00	67		
1223	3.64	34.568	1.85	2.84	110	0.00	59		
1211	3.71	34.561	1.78	2.89	104	0.00	60		
1493	3.02	34.593	2.10	2.93	123	0.00	52		
1775	2.56	34.622	2.45	2.92	140	0.00	46		
2058	2.19	34.646	2.85	2.75	138	0.00	41		
2340	1.94	34.663	3.31	2.49	138	0.00	38		
2624	1.84	34.681h)	3.39	2.43	140	0.00	36		
2908	1.81	34.693	3.34	2.38	145	0.00	34		
3194	1.82	34.690	3.31	2.39	147	0.00	34		
3484	1.83	34.686	3.35	2.39	147	0.00	35		

- a) One value only.
 b) Average of 19.63 and 19.59°C.
 c) Alternate value, 16.36°C.
 d) Average of 14.35 and 14.31°C.
 e) Alternate value, 20.04°C.
 f) Average of 15.35 and 15.31°C.
 g) Average of 5.73 and 5.77°C.
 h) Alternate value, 34.695%.

SIO
STEP - I

72

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; November 29, 1960; 1309 GCT; 13°20'S, 94°57'W; sounding, 1960 fm; wind, 110°, force 10 kt; weather, cloudy; sea, missing; wire angle, 15°.

0	21.02	35.868	5.13	0.63	5	0.11	281	0	0.000
33	21.00	35.859	4.98	0.63	7	0.09	281	10	0.029
58	20.84	35.835	5.05	0.63	5	0.08	279	20	0.056
76	20.07	35.823	5.01	0.58	3	0.14	260	30	0.084
105	19.70	35.742	4.99	0.56	2	0.09	256	50	0.140
139	19.26	35.632	4.91	0.59	3	0.44	254	75	0.208
168	(17.4)a	35.276	3.99	0.99	4	0.03	235	100	0.272
191	14.78	34.930	2.83	1.52	9	trace	203	150	0.400
211	13.00	34.726	2.11	1.83	12	trace	183	200	0.512
238	11.68	34.702	0.68	2.41	25	0.00	161	250	0.599
266	11.18	34.750	0.31	2.54	31	0.00	148	300	0.672
311	10.34	34.724	0.38	2.58	33	0.00	135	400	0.800
413	8.80	34.657	0.84	2.58	37	0.00	116	500	0.911
513	7.46	34.579	0.92	2.69	45	0.00	103	600	1.010
615	6.37	34.522	0.97	2.83	51	0.00	93	700	1.099
716	5.62	34.524	0.94	2.93	65	0.00	84	800	1.180
818	5.05	34.516	1.08	2.94	74	0.00	78	1000	1.327
921	4.54	34.530	1.31	2.93	84	0.00	71		
1024	4.25	34.543	1.53	2.93	94	0.00	67		
1231	3.59	34.566	1.88	2.76	110	0.00	59		

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HORIZON; November 30, 1960; 0235 GCT; 11°35'S, 94°59'W; sounding, 1840 fm; wind, 130°, force 8 kt; weather, cloudy; sea, missing; wire angle, missing.

0	20.87b)	35.736	5.13	0.78	4	0.18	287	0	0.000
10	20.86	35.734	5.16	0.78	7	0.18	287	10	0.029
32	20.66	35.720	5.12	0.76	6	0.19	282	20	0.057
60	20.44	35.715	5.10	0.75	4	0.20	277	30	0.086
93	19.84	35.712	5.03	0.85	4	0.28	262	50	0.142
125	19.46	35.583	4.66	0.75	3	0.68	262	75	0.210
143	17.16	35.295	3.65	1.07	6	0.07	228	100	0.277
162	14.56c)	34.933	2.03	1.75	13	0.02	198	150	0.396
185	13.22	34.842	0.46	2.39	21	trace	179	200	0.492
204	12.58	34.843	0.25	2.42	24	0.00	166	250	0.572
249	11.81	34.870	0.38	2.42	30	0.00	150	300	0.644
305	10.86	34.810	0.51	2.42	34	0.00	138	400	0.776
408	9.63	34.739	0.43	2.56	40	0.00	123	500	0.891
508	8.02	34.631	0.82	2.57	43	0.00	107	600	0.993
611	6.75	34.562	0.65	2.84	52	0.00	94	700	1.083
713	5.70d)	34.534	1.02	2.92	63	0.00	84	800	1.164
816	5.10	34.535	1.14	2.83	75	0.00	77	1000	1.308
920	4.54	34.542	1.57	2.82	85	0.00	70		
1025	4.18	34.555	1.76	2.79	97	0.00	65		
1229	3.53	34.579	1.96	2.75	112	0.00	57		

- a) Thermometer readings of 15.78 and 15.88°C.
b) One value only.
c) Average of 14.58 and 14.54°C.
d) Average of 5.67 and 5.72°C.

OBSERVED								COMPUTED	
Z m	T °C	S ‰	O ₂ ml/L	PO ₄ -P μg at/L	SiO ₃ μg at/L	NO ₂ -N μg at/L	δ _T 10 ⁵ cm ³ /g	Z m	ΔD' dyn m

HORIZON; November 30, 1960; 1621, 1403 GCT; 9°57'S, 95°02'W; sounding, 2000 fm; wind, 110°, force 11 kt; weather, cloudy; sea, missing; wire angle, 22°, 38°.

74

0	21.44	35.567	4.92	0.91	6	0.27	313	0	0.000
24	21.34	35.576	5.04	0.91	9	0.28	310	10	0.031
41	21.24	35.585	5.04	0.90	6	0.28	307	20	0.062
59	21.18	35.585	5.04	0.90	6	0.28	306	30	0.094
82	19.54a)	35.490	4.17	1.12	5	0.70	270	50	0.155
100	16.68	35.181	3.00	1.42	8	0.48	226	75	0.229
132	13.86	34.889	0.83	2.15	17	0.02	187	100	0.293
160	12.54	34.839	0.55	2.31	24	0.00	166	150	0.393
182	12.02	34.835	0.47	2.40	27	0.00	157	200	0.473
199	11.66	34.854	0.39	2.40	31	0.00	148	250	0.545
243	11.29	34.827	0.51	2.41	33	0.00	144	300	0.615
298	10.70	34.796	0.32	2.53	37	0.00	136	400	0.744
396	9.53	34.724	0.39	2.58	41	0.00	122	500	0.859
495	8.14	34.627	0.23	2.82	48	0.00	108	600	0.962
596	7.08	34.571	0.34	2.93	55	0.00	98	700	1.055
696	6.16	34.543	0.58	3.01	63	0.00	88	800	1.139
798	5.50	34.535	0.71	3.04	74	0.00	81	1000	1.289
901	4.86	34.533	1.09	3.01	83	0.00	74		
1005	4.45	34.546	1.43	2.90	92	0.00	69		
1214	3.72	34.564	1.92	2.86	109	0.00	60		
1159	3.80	34.575	1.74	2.89	108	0.00	60		
1425	3.04	34.606	2.09	2.75	130	0.00	51		
1690	2.54	34.625	2.31	2.63	144	0.00	45		
1954	2.26	34.645	2.48	2.63	152	0.00	42		
2218	2.06	34.659	2.74	2.55	153	0.00	39		
2481	1.86	34.673	3.18	2.45	151	0.00	36		
2743	1.78	34.688	3.28	2.44	151	0.00	34		
3004	1.80	34.686	3.26	2.46	151	0.00	34		
3285	1.82	34.678	3.22	2.47	151	0.00	36		

HORIZON; December 1, 1960; 0251 GCT; 8°25'S, 94°56'W; sounding, 2150 fm; wind, 120°, force 11 kt; weather, cloudy; sea, missing; wire angle, 12°.

75

0	22.32	35.410	4.84	0.94	6	0.25	348	0	0.000
10	22.30	35.396	4.94	0.88	8	0.24	349	10	0.035
33	22.24	35.396	4.96	0.88	7	0.25	347	20	0.070
53	21.88	35.353	4.98	0.92	6	0.26	341	30	0.104
77	17.42	35.267	3.61	1.25	5	0.37	236	50	0.174
97	15.06	35.023	0.37	2.30	16	0.41	203	75	0.247
130	13.38	34.944	0.20	2.42	24	0.03	174	100	0.303
159	12.68b)	34.911	0.23	2.45	28	0.00	163	150	0.394
192	12.24	34.893	0.29	2.46	28	0.00	156	200	0.474
211	12.02	34.882	0.32	2.42	29	0.00	156	250	0.550
259	11.45	34.841	0.29	2.50	33	0.00	146	300	0.621
315	10.71	34.791	0.33	2.56	36	0.00	137	400	0.752
420	9.24	34.708	0.25	2.82	42	0.00	119	500	0.866
523	7.50	34.602	0.29	3.00	53	0.00	102	600	0.965
627	6.53	34.567	0.64	3.01	59	0.00	91	700	1.054
732	5.72	34.544	1.20	3.01	67	0.00	83	800	1.136
837	5.13	34.546	1.15	3.02	81	0.00	76	1000	1.282
942	4.70	34.544	1.40	3.01	88	0.00	72		
1049	4.30	34.558	1.40	3.02	100	0.00	66		
1260	3.58	34.570	1.93	2.86	114	0.00	58		

a) Average of 19.57 and 19.52°C.

b) Average of 12.70 and 12.65°C.

SIO

STEP-I

76

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

HORIZON; December 1, 1960; 1241 GCT; 6°51'S, 94°52'W; sounding, 2170 fm; wind, 115°, force 6 kt; weather, cloudy; sea, missing; wire angle, 01°.

0	22.42a)	35.180	4.94	0.90	8	0.20	368	0	0.000
25	22.42	35.239	4.87	0.90	10	0.21	364	10	0.037
45	22.22	35.324	4.94	0.89	9	0.24	352	20	0.073
65	22.03b)	35.344	4.91	0.93	7	0.24	346	30	0.110
89	15.80c)	35.091	1.40	2.00	12	0.59	213	50	0.181
109	14.04	34.993	0.21	2.36	22	0.15	184	75	0.261
132	13.12	34.957	0.30	2.36	26	0.00	168	100	0.321
153	12.61	34.928	0.33	2.35	29	0.00	160	150	0.409
186	12.08	34.893	0.46	2.39	29	0.00	154	200	0.487
216	11.81	34.878	0.47	2.39	30	0.00	149	250	0.561
264	11.20	34.834	0.34	2.56	34	0.00	142	300	0.631
322	10.34	34.779	0.27	2.68	40	0.00	131	400	0.759
429	9.14	34.705	0.23	2.75	46	0.00	118	500	0.874
534	7.68	34.617	0.19	3.02	58	0.00	103	600	0.975
640	6.56	34.578	0.30	3.09	66	0.00	90	700	1.065
748	5.78d)	34.561	0.65	3.05	76	0.00	82	800	1.148
854	5.16	34.549	1.14	3.07	83	0.00	76	1000	1.297
962	4.66	34.546	1.49	3.06	92	0.00	71		
1070	4.30	34.558	1.59	3.02	104	0.00	66		
1280	3.58	34.573	1.93	2.92	118	0.00	58		

77

HORIZON; December 2, 1960; 0544, 0243 GCT; 5°00'S, 95°00'W; sounding, 2040 fm; wind, 110°, force 9 kt; weather, cloudy; sea, missing; wire angle, 22°, 43°.

0	21.73e)	34.771	4.93	0.92	18	0.16	378	0	0.000
10	21.70	34.852	4.83	0.86	25	0.16	372	10	0.038
31	21.48	34.918	4.99	0.86	24	0.17	362	20	0.075
63	19.75	35.009	4.28	1.06	18	0.56	310	30	0.111
89	15.48	35.081	1.35	1.85	20	1.29	207	50	0.183
108	13.82	34.981	0.70	2.11	27	0.04	180	75	0.260
134	13.30	34.963	0.71	2.11	30	0.01	171	100	0.317
160	13.04	34.939	0.73	2.14	35	0.01	168	150	0.406
196	12.72	34.920	0.57	2.20	35	trace	163	200	0.488
212	12.60	34.928	0.48	2.23	32	0.00	160	250	0.568
265	12.18	34.887	0.35	2.32	37	0.00	155	300	0.644
317	11.58	34.858	0.66	2.26	36	0.00	146	400	0.784
431	9.68	34.739	0.19	2.66	47	0.00	124	500	0.904
534	7.76	34.623	0.22	2.91	55	0.00	104	600	1.006
639	6.42	34.569	0.60	3.04	65	0.00	90	700	1.095
744	5.72	34.553	1.09	3.06	75	0.00	82	800	1.177
853	5.10	34.549	1.44	2.97	89	0.00	76	1000	1.324
947	4.65	34.555	1.44	2.96	94	0.00	70		
1065	4.26	34.564	1.63	2.89	105	0.00	66		
1285	3.60	34.581	1.91	2.80	120	0.00	58		
1276	3.59	34.613	1.88	2.90	122	0.00	55		
1545	2.95	34.620	2.13	2.81	138	0.00	49		
1813	2.50	34.633	2.26	2.68	160	0.00	44		
2082	2.20	34.659	2.43	2.63	163	0.00	40		
2351	2.04	34.663	2.62	2.63	175	0.00	39		
2621	1.86	34.685	2.87	2.52	168	0.00	36		
2896	1.76	34.682	3.08	2.50	151	0.00	35		
3175	1.78e)	34.679	3.11	2.50	171	0.00	36		
3457	1.80	34.678	3.07	2.51	176	0.00	36		

a) Alternate value, 22.57°C.

b) Alternate value, 21.79°C.

c) Average of 15.83 and 15.78°C.

d) Average of 5.76 and 5.80°C.

e) One value only.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ _T	Z	ΔD'
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; December 2, 1960; 1352 GCT; 3°56'S, 95°07'W; sounding, 2010 fm; wind, 135°, force 9 kt; weather, cloudy; sea, missing; wire angle, 19°.

0	21.61	34.624	4.95	0.91	8	0.13	386	0	0.000
17	21.08	34.861	4.71	0.87	12	0.17	358	10	0.038
32	17.64	35.155	2.24	1.65	15	1.58	250	20	0.074
56	14.90	35.064	1.14	1.92	20	0.32	196	30	0.104
83	14.03a)	35.027	1.55	1.89	21	0.66	181	50	0.151
102	13.82	35.007	1.60	1.89	21	0.57	178	75	0.199
121	13.44	34.975	1.62	1.87	22	0.02	173	100	0.244
159	13.12	34.952	1.52	1.92	24	trace	168	150	0.331
197	12.98	34.948	0.97	2.07	26	trace	166	200	0.416
223	12.75	34.935	0.69	2.17	27	trace	162	250	0.496
279	12.28	34.908	0.34	2.38	31	0.00	156	300	0.574
335	11.58	34.862	0.41	2.49	33	0.00	146	400	0.713
450	9.03	34.713	0.20	2.82	48	0.00	116	500	0.831
557	7.60	34.646	0.44	2.90	57	0.00	100	600	0.933
664	6.74	34.603	0.59	3.00	66	0.00	92	700	1.025
772	5.90	34.573	0.99	3.01	76	0.00	83	800	1.110
886	5.34	34.564	1.25	2.95	83	0.00	77	1000	1.262
981	4.74	34.561	1.44	2.96	93	0.00	71		
1103	4.20	34.579	1.63	2.88	107	0.00	64		
1327	3.56	34.591	1.89	2.88	124	0.00	57		

HORIZON; December 2, 1960; 2053 GCT; 2°59'S, 94°57'W; sounding, 1700 fm; wind, 180°, force 18 kt; weather, partly cloudy; sea, missing; wire angle, 15°.

0	21.70b)	34.637	4.92	0.96	9	0.17	388	0	0.000
11	21.51	34.650	4.86	0.94	12	0.17	382	10	0.039
24	17.72	34.914	3.27	1.09	15	0.43	268	20	0.073
43	15.04	35.020	2.41	1.64	18	0.58	202	30	0.100
67	13.58	34.974	2.17	1.67	22	0.17	175	50	0.142
106	13.36	34.953	2.17	1.69	21	0.01	173	75	0.188
144	13.27	34.955	2.08	1.77	22	0.01	171	100	0.232
173	13.23c)	34.950	2.06	1.77	22	trace	171	150	0.318
211	13.19	34.948	1.93	1.83	23	0.00	170	200	0.403
230	13.08	34.940	1.78	1.81	24	0.00	169	250	0.488
288	12.66	34.922	0.83	2.23	28	0.00	162	300	0.570
345	11.83	34.885	0.32	2.50	32	0.00	150	400	0.714
464	8.52	34.680	0.31	2.94	51	0.00	110	500	0.830
575	7.19	34.613	0.96	2.85	58	0.00	96	600	0.930
683	6.25	34.581	1.20	2.91	66	0.00	86	700	1.020
793	5.59	34.579	1.24	3.02	82	0.00	79	800	1.102
907	4.89	34.575	1.75	2.90	90	0.00	72	1000	1.247
1003	4.55	34.574	1.73	2.96	94	0.00	68		
1124	4.14	34.593	1.65	2.95	111	0.00	62		
1349	3.44	34.611	1.86	2.91	133	0.00	54		

a) Average of 14.05 and 14.01°C.

b) One value only.

c) Average of 13.25 and 13.21°C.

S10

STEP-1

78

79

SIO
STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

80

HORIZON; December 3, 1960; 0428 GCT; 1°59'S, 94°55'W; sounding, 1800 fm; wind, 135°, force 10 kt; weather, cloudy; sea, missing; wire angle, 08°.

0	21.28	34.788	4.78	0.96	a)	0.18	366	0	0.000
25	20.76	34.801	4.71	0.95		0.16	351	10	0.037
44	18.36	34.958	3.52	1.24		0.35	280	20	0.073
63	14.88	35.032	1.93	1.70		0.85	198	30	0.108
88	13.65	34.983	1.98	1.65		0.02	177	50	0.165
108	13.49	34.965b)	2.09	1.80		0.01	175	75	0.218
131	13.25	34.945	1.90	1.72		trace	172	100	0.262
151	13.16	34.937	2.03	1.71		trace	170	150	0.349
184	13.10c)	34.930	1.82	1.75		trace	170	200	0.433
214	13.04	34.927	1.73	1.83		0.00	168	250	0.517
262	12.86	34.919	1.35	1.94		0.00	166	300	0.598
321	11.70	34.859	0.24	2.48		0.00	149	400	0.739
427	9.50	34.725	0.38	2.55		0.00	122	500	0.858
531	7.90	34.629	1.14	2.55		0.00	105	600	0.961
636	6.82	34.579	1.35	2.71		0.00	94	700	1.054
742	5.84	34.564	1.26	2.80		0.00	84	800	1.137
848	5.04	34.563	1.50	2.80		0.00	74	1000	1.284
954	4.62	34.553	1.88	2.78		0.00	70		
1061	4.16	34.569	1.72	2.94		0.00	64		
1271	3.54	34.591	1.93	2.97		0.00	56		

81

HORIZON; December 3, 1960; 1203 GCT; 0°58'S, 94°54'W; sounding, 1800 fm; wind, 185°, force 9 kt; weather, cloudy; sea, missing; wire angle, 03°.

0	21.08	34.513	4.58	0.76	13	0.13	381	0	0.000
10	21.06	34.516	4.70	0.79	12	0.13	380	10	0.038
34	20.20	34.693	4.54	0.92	15	0.16	345	20	0.075
55	19.32	34.857	4.20	1.05	14	0.18	311	30	0.111
79	17.28	35.050	2.40	1.37	16	0.69	249	50	0.179
99	15.09	35.086	1.39	1.85	20	0.67	199	75	0.251
133	13.72	34.995	1.34	1.85	23	0.03	177	100	0.308
153	13.19	34.957	1.76	1.85	26	0.01	169	150	0.399
187	12.88d)	34.914	1.78	1.85	26	0.00	167	200	0.483
216	12.83	34.924	1.65	1.85	26	0.00	165	250	0.566
265	12.72	34.919	1.51	1.96	26	0.00	163	300	0.647
322	12.24	34.902	0.40	2.27	33	0.00	156	400	0.789
428	9.09	34.699	0.65	2.52	46	0.00	118	500	0.905
533	7.65	34.618	1.09	2.63	55	0.00	102	600	1.006
638	6.75	34.579	1.41	2.70	59	0.00	93	700	1.098
744	5.96	34.565	1.45	2.80	74	0.00	84	800	1.181
849	5.06	34.562	1.66	2.81	86	0.00	74	1000	1.326
957	4.58	34.560	1.83	2.78	98	0.00	69		
1065	4.30	34.569	1.92	2.78	105	0.00	66		
1275	3.66	34.602	1.78	2.94	126	0.00	57		

a) Silicate samples rejected.

b) Alternate value, 34.976‰.

c) Average of 13.12 and 13.08°C.

d) Average of 12.90 and 12.86°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; December 3-4, 1960; 0110, 2250 GCT; 0°00', 95°03'W; sounding, 1770 fm; wind, 150°, force 18 kt; weather, cloudy; sea, missing; wire angle, 24°, 18°.

82

0	22.52a)	34.038	4.59	0.55	7	0.07	453	0	0.000
22	20.45	34.418	4.10	0.84	10	0.14	371	10	0.045
40	19.39	34.830	3.71	1.04	13	0.24	314	20	0.087
58	18.24b)	34.98c)	2.97	1.23	13	0.48	276	30	0.123
79	15.90	35.09c)	2.77	1.34	14	0.04	215	50	0.186
87	14.62	34.96c)	2.60	1.46	18	0.01	198	75	0.251
119	14.04	34.943	2.47	1.51	19	trace	188	100	0.304
136	13.47d)	34.958	2.55	1.57	21	0.00	174	150	0.396
166	13.10	34.920	2.29	1.70	21	0.00	170	200	0.481
192	12.88	34.918	2.16	1.73	21	0.00	166	250	0.563
234	12.78	34.916	1.89	1.83	23	0.00	164	300	0.641
287	12.07	34.875	0.59	2.07	32	0.00	154	400	0.776
380	9.78	34.741	0.53	2.58	40	0.00	125	500	0.888
475	8.02	34.641	0.72	2.75	53	0.00	106	600	0.985
570	6.82	34.588	1.16	2.81	60	0.00	94	700	1.074
666	6.41	34.574	1.27	2.85	65	0.00	90	800	1.157
762	5.82	34.578	1.19	2.88	81	0.00	82	1000	1.306
863	5.28	34.575	1.34	2.92	87	0.00	76		
964	4.84	34.570	1.57	2.88	95	0.00	72		
1170	4.00	34.592	1.78	2.90	114	0.00	61		
1171	4.04	34.581	1.74	2.89	115	0.00	62		
1447	3.20	34.628	1.93	2.86	133	0.00	50		
1717	2.62	34.631	2.21	2.70	153	0.00	46		
1986	2.32	34.649	2.40	2.73	153	0.00	42		
2255	2.00	34.668	2.65	2.71	163	0.00	38		
2532	1.85	34.669	2.86	2.61	164	0.00	36		
2818	1.78	34.685	3.06	2.57	170	0.00	36		
3106	1.78	34.685	3.01	2.57	170	0.00	36		

HORIZON; December 4, 1960; 1245 GCT; 1°08'N, 95°10'W; sounding, 2000 fm; wind, 160°, force 18 kt; weather, overcast; sea, missing; wire angle, 40°.

83

0	24.85	33.622	4.43	0.31	6	0.02	548	0	0.000
9	24.83	33.619	4.68	0.33	6	trace	548	10	0.055
20	24.86c)	33.617	4.69	0.31	8	0.00	548	20	0.110
36	24.68	33.650	4.69	0.31	7	trace	541	30	0.164
51	19.62	34.442	4.02	1.00	12	0.14	349	50	0.255
69	17.20	34.730	3.26	1.34	15	0.26	270	75	0.332
84	15.94	34.821	2.72	1.44	18	0.50	236	100	0.388
111	14.20	34.950	2.31	1.59	23	0.02	190	150	0.482
142	13.72	34.940	1.95	1.78	23	0.00	181	200	0.569
165	13.30	34.849e)	-	1.63	22	0.06	179	250	0.651
200	12.90	34.910	1.52	1.93	25	0.00	167	300	0.732
241	12.76	34.904	2.01	1.83	26	0.00	165	400	0.875
317	12.10	34.871	0.71	2.29	30	0.00	156	500	0.991
394	9.91	34.742	0.39	2.55	43	0.00	127	600	1.093
472	8.61	34.668	0.60	2.69	48	0.00	112	700	1.185
552	7.48	34.618	0.80	2.77	57	0.00	100	800	1.267
635	7.02	34.598	1.03	2.80	60	0.00	96	1000	1.412
722	6.05	34.582	1.12	2.90	74	0.00	84		
817	5.43	34.576	1.29	2.93	86	0.00	78		
1015	4.40	34.579	1.58	2.91	104	0.00	66		

- a) Alternate value, 21.08°C.
 b) Average of 18.28 and 18.21°C.
 c) One value only.
 d) Average of 13.49 and 13.45°C.
 e) Alternate value, 34.838‰.

SIO

STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

84

HORIZON; December 4, 1960; 1845 GCT; 1°59'N, 95°02'W; sounding, 1520 fm; wind, 155°, force 12 kt; weather, overcast; sea, missing; wire angle, 22°.

0	25.12	33.622	4.45	0.42	6	0.00	556	0	0.000
17	25.07	33.624	4.68	0.32	5	0.00	554	10	0.056
31	25.04	33.631	4.70	0.28	9	0.00	552	20	0.111
45	23.43	33.911	4.38	0.54	9	0.02	487	30	0.166
60	21.03a)	34.331	3.73	0.90	11	0.17	393	50	0.267
82	15.44	34.911	2.50	1.48	19	0.36	218	75	0.358
101	14.69	34.949	2.23	1.57	20	0.38	200	100	0.417
122	14.30	34.973	2.12	1.63	21	0.02	190	150	0.514
159	14.00	34.946	2.10	1.64	21	0.00	186	200	0.604
200	13.40	34.934	1.62	1.90	23	0.00	175	250	0.689
245	12.82	34.908	1.19	2.05	27	0.00	166	300	0.769
298	11.88	34.844	0.60	2.32	33	0.00	153	400	0.907
399	9.66	34.721	0.42	2.62	43	0.00	124	500	1.024
497	8.50	34.662	0.48	2.85	52	0.00	111	600	1.130
598	7.48	34.614	0.71	2.85	58	0.00	101	700	1.223
699	6.32	34.584	0.95	3.03	69	0.00	87	800	1.306
799	5.42	34.568	1.33	2.91	84	0.00	78	1000	1.452
899	4.87	34.559	1.57	2.91	91	0.00	72		
1002	4.44	34.564	1.56	2.92	101	0.00	68		
1205	3.72	34.592	1.75	2.91	124	0.00	58		

85

HORIZON; December 5, 1960; 0321 GCT; 3°00'N, 95°03'W; sounding, 1600 fm; wind, 140°, force 16 kt; weather, overcast; sea, missing; wire angle, 25°.

0	25.89b)	33.306	4.53	0.25	10	trace	601	0	0.000
10	25.89	33.302	4.64	0.30	10	0.00	602	10	0.060
31	25.90	33.301	4.62	0.29	17	0.00	602	20	0.120
49	16.84	34.831	2.79	1.34	21	0.20	255	30	0.181
58	15.68	34.938	2.48	1.53	19	0.33	222	50	0.266
70	15.03	35.002	2.19	1.57	23	0.39	204	75	0.323
80	14.81	35.001	2.08	1.57	25	0.21	199	100	0.372
121	14.26	34.966	2.15	1.59	28	trace	190	150	0.467
169	13.70	34.942	2.16	1.66	28	0.00	180	200	0.556
198	13.34c)	34.924	1.76	1.79	26	0.00	174	250	0.641
241	12.92	34.917	1.36	2.02	30	0.00	167	300	0.722
296	12.13	34.853	0.87	2.18	35	0.00	158	400	0.860
394	9.31	34.690	0.34	2.66	50	0.00	121	500	0.973
493	8.21	34.647	0.33	2.87	64	0.00	108	600	1.077
591	7.48	34.620	0.51	2.86	64	0.00	100	700	1.170
688	6.48	34.589	0.65	3.01	79	0.00	89	800	1.254
788	5.62	34.570	1.03	2.95	86	0.00	80	1000	1.401
888	5.10	34.570	1.16	2.95	95	0.00	74		
988	4.50	34.570	1.35	2.99	113	0.00	66		
1188	3.83	34.584	1.66	2.93	130	0.00	60		

a) Average of 21.05 and 21.01°C.

b) One value only.

c) Average of 13.32 and 13.36°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

SIO
STEP-1

HORIZON; December 5, 1960; 1115 GCT; 4°02'N, 94°56'W; sounding, 1750 fm; wind, 155°, force 10 kt; weather, partly cloudy; sea, missing; wire angle, 12°.

86

0	26.28a)	33.142	4.47	0.58	11	0.00	625	0	0.000
24	26.26	33.138	4.60	0.63	13	0.00	625	10	0.062
43	23.32	34.206	3.78	0.84	18	0.24	462	20	0.125
58	16.83	34.684	1.70	1.86	27	0.47	266	30	0.187
76	14.26	34.807	1.50	1.90	25	0.05	201	50	0.286
96	14.09	34.904	1.40	1.97	27	0.03	191	75	0.357
125	13.74	34.915	1.23	1.96	29	trace	183	100	0.406
149	13.48b)	34.909	1.24	2.06	31	0.00	178	150	0.498
182	13.04c)	34.888	1.16	2.11	31	0.00	172	200	0.585
211	12.60	34.852	1.06	2.20	31	0.00	166	250	0.666
258	12.00	34.820	0.94	2.28	35	0.00	157	300	0.743
316	10.98	34.743	0.95	2.32	39	0.00	145	400	0.880
421	9.04	34.651	0.38	2.75	52	0.00	121	500	0.997
524	7.86	34.614	0.38	2.96	64	0.00	106	600	1.101
628	7.09	34.578	0.65	2.95	65	0.00	98	700	1.196
734	6.15	34.554	0.75	3.08	83	0.00	87	800	1.282
839	5.34	34.544	1.12	3.02	94	0.00	78	1000	1.433
944	4.80	34.542	1.29	3.00	99	0.00	73		
1050	4.44	34.546	1.42	3.03	113	0.00	69		
1258	3.62	34.571	1.66	2.90	131	0.00	59		

HORIZON; December 5, 1960; 2310, 2000 GCT; 5°00'N, 95°00'W; sounding, 1908 fm; wind, 195°, force 10 kt; weather, cloudy; sea, missing; wire angle, 11°, 22°.

87

0	26.72	33.060	4.36	0.22	4	0.00	642	0	0.000
10	26.70	33.064	4.53	0.21	5	0.00	642	10	0.064
33	26.51d)	33.118	4.57	0.22	5	0.00	633	20	0.128
52	21.46	34.650	3.02	1.20	11	0.79	381	30	0.192
76	15.34	34.741	1.04	2.03	24	0.27	229	50	0.296
95	13.58	34.781	1.15	2.05	28	0.02	190	75	0.375
120	12.82	34.794	1.35	2.05	28	trace	174	100	0.428
139	12.36	34.783	1.64	2.04	30	0.00	167	150	0.516
182	11.94	34.811	1.25	2.15	30	0.00	156	200	0.595
210	11.66	34.791	1.47	2.15	30	0.00	153	250	0.670
259	11.20	34.784	0.82	2.37	35	0.00	146	300	0.742
316	10.42	34.729	0.92	2.35	38	0.00	137	400	0.872
422	8.98	34.664	0.30	2.86	52	0.00	118	500	0.986
525	7.55	34.606	0.53	3.00	62	0.00	102	600	1.085
630	6.46	34.577	0.84	3.12	71	0.00	89	700	1.174
734	5.90	34.564	1.00	3.01	81	0.00	84	800	1.257
841	5.38	34.566	0.89	3.08	89	0.00	78	1000	1.406
946	4.87	34.570	0.95	3.14	100	0.00	71		
1052	4.44	34.583	1.13	3.10	112	0.00	66		
1262	3.71	34.602	1.47	3.08	128	0.00	57		
1225	3.88	34.601	1.34	3.05	124	0.00	60		
1511	3.13	34.625	1.79	2.99	142	0.00	50		
1791	2.66	34.637	2.09	2.92	154	0.00	45		
2076	2.24	34.657	2.37	2.81	155	0.00	40		
2358	1.96	34.671	2.51	2.73	169	0.00	37		
2643	1.84	34.676	2.62	2.73	171	0.00	36		
2928	1.82	34.678	2.78	2.64	171	0.00	36		
3216	1.84	34.678	2.85	2.64	171	0.00	36		
3507	1.86	34.678	2.90	2.70	171	0.00	36		

a) One value only.

b) Average of 13.50 and 13.45°C.

c) Average of 13.06 and 13.01°C.

d) Average of 26.53 and 26.49°C.

SIO

STEP-1

88

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; December 6, 1960; 1002 GCT; 6°46'N, 95°01'W; sounding, 1990 fm; wind, 030°, force 19 kt; weather, partly cloudy; sea, missing; wire angle, 15°.

0	26.65a)	33.121	4.23	0.25	6	trace	637	0	0.000
24	26.64	33.110	4.54	0.21	9	trace	637	10	0.064
43	19.60	34.608	2.13	1.65	17	0.53	336	20	0.128
62	15.79	34.676	1.44	1.89	21	0.13	243	30	0.191
80	13.73b)	34.732	1.59	1.92	25	0.03	196	50	0.285
95	13.60	34.858	1.16	2.04	25	trace	184	75	0.348
119	13.27c)	34.884	1.02	2.12	25	trace	176	100	0.396
147	12.88	34.866	1.16	2.13	27	0.00	170	150	0.483
178	12.64	34.875	0.53	2.30	28	0.00	165	200	0.566
206	12.38	34.861	0.56	2.36	28	0.00	161	250	0.645
250	11.70	34.815	0.38	2.42	32	0.00	152	300	0.719
304	11.01	34.774	0.31	2.55	37	0.00	144	400	0.853
405	9.43	34.686	0.20	2.89	49	0.00	124	500	0.970
503	8.12	34.624	0.16	3.06	62	0.00	108	600	1.073
603	6.98	34.587	0.27	3.16	69	0.00	96	700	1.164
703	6.24	34.570	0.52	3.27	75	0.00	88	800	1.249
804	5.64	34.564	0.68	3.22	86	0.00	81	1000	1.399
908	5.08	34.562	0.75	3.22	94	0.00	75		
1015	4.62	34.570	0.92	3.21	105	0.00	69		
1226	3.86	34.589	1.15	3.17	125	0.00	60		

89

HORIZON; December 6, 1960; 2052 GCT; 8°18'N, 95°01'W; sounding, 1950 fm; wind, 085°, force 14 kt; weather, partly cloudy; sea, missing; wire angle, 19°.

0	26.98	33.144	4.33	0.34	8	0.02	645	0	0.000
10	26.87	33.137	4.55	0.32	11	0.02	642	10	0.054
33	17.75	34.664	1.44	1.90	23	0.17	288	20	0.128
42	15.93	34.702	1.31	1.93	23	0.25	244	30	0.177
52	14.83	34.721	1.01	2.03	27	0.25	220	50	0.231
61	13.83	34.741	0.93	2.13	28	0.21	198	75	0.282
75	13.25	34.783	0.87	2.14	28	0.08	184	100	0.327
103	12.90	34.821	0.87	2.24	29	0.04	174	150	0.412
154	12.50	34.847	0.87	2.29	29	trace	164	200	0.492
204	11.92	34.784	0.98	2.30	31	trace	158	250	0.570
250	11.40	34.780	0.51	2.42	35	0.00	150	300	0.642
304	10.75	34.747	0.55	2.57	38	0.00	141	400	0.778
405	9.86	34.706	0.37	2.58	45	0.00	130	500	0.898
504	8.22	34.622	0.14	3.01	64	0.42	110	600	1.003
604	7.08	34.589	0.19	3.11	73	0.01	97	700	1.095
704	6.08	34.580	0.23	3.13	85	0.00	85	800	1.176
806	5.50	34.581	0.40	3.26	93	0.00	78	1000	1.322
908	4.94	34.583	0.55	3.20	101	0.00	71		
1014	4.45	34.574	0.72	3.19	113	0.00	66		
1220	3.78	34.596	1.08	3.15	130	0.00	58		

a) One value only.

b) Average of 13.75 and 13.71°C.

c) Alternate value, 12.81°C.

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δT	Z	$\Delta D'$
m	°C	‰	ml/L	μg at/L	μg at/L	μg at/L	10 ⁵ cm ³ /g	m	dyn m

HORIZON; December 7, 1960; 1141, 0849 GCT; 10°05'N, 95°06'W; sounding, 2090 fm; wind, 005°, force 7 kt; weather, partly cloudy; sea, missing; wire angle, 04°, 20°.

0	26.67a)	33.493	4.21	0.74	7	0.09	610	0	0.000
10	26.66	33.485	4.42	0.75	11	0.08	610	10	0.061
25	19.56b)	34.554	1.67	1.82	21	0.20	338	20	0.119
44	14.53	34.812	0.43	2.20	27	0.22	207	30	0.161
64	13.62c)	34.827	0.32	2.26	29	0.10	187	50	0.210
89	12.87	34.778	0.97	2.13	29	0.05	176	75	0.258
124	12.38	34.805	0.95	2.18	30	0.02	165	100	0.302
154	12.06d)	34.808	0.98	2.18	32	trace	159	150	0.385
187	11.87	34.810	0.79	2.23	32	trace	156	200	0.463
216	11.70	34.817	0.60	2.34	32	trace	152	250	0.539
265	11.14	34.769	0.75	2.32	33	trace	145	300	0.611
323	10.76	34.753	0.67	2.39	38	trace	140	400	0.746
429	9.48	34.689	0.11	2.83	51	0.00	124	500	0.866
534	7.84	34.608	0.15	3.08	68	0.42	106	600	0.970
639	6.77	34.580	0.10	3.11	77	0.00	93	700	1.062
744	6.07	34.570	0.16	3.20	87	0.00	85	800	1.147
850	5.36	34.562	0.32	3.18	95	0.00	78	1000	1.298
958	4.84	34.566	0.50	3.18	105	0.00	72		
1066	4.42	34.574	0.73	3.17	114	0.00	66		
1276	3.67	34.588	1.08	3.03	134	0.00	58		
1384	3.42	34.599	1.05	3.12	139	0.00	55		
1678	2.80	34.624	1.62	2.96	154	0.00	48		
1970	2.34	34.646	2.01	2.60	164	0.00	42		
2263	1.98	34.660	2.32	2.59	171	0.00	38		
2556	1.88e)	34.672	2.56	2.60	172	0.00	36		
2849	1.86	34.671	2.63	2.60	172	0.00	36		
3140	1.84	34.673	2.69	2.62	172	0.00	36		
3432	1.88	34.672	2.75	2.65	172	0.00	36		
3747	1.90	34.675	2.80	2.62	172	0.00	36		

HORIZON; December 8, 1960; 1915 GCT; 13°56'N, 99°54'W; sounding, missing; wind, missing; weather, missing; sea, missing; wire angle, missing.

0f)	33.43	4.37	0.21	13	0.00
25	33.40	4.43	0.19	25	trace
39	34.02	4.67	0.30	22	trace
49	34.27	4.43	0.44	19	0.02
59	34.52	2.25	1.37	18	1.21
146	34.84	0.11	2.40	37	trace
214	34.83	0.09	2.43	45	0.00
322	34.73	0.12	2.64	53	0.07
429	34.64	0.07	2.93	61	1.06
536	34.60	0.07	3.14	78	0.64

- a) One value only.
b) Average of 19.59 and 19.54°C.
c) Average of 13.64 and 13.59°C.
d) Average of 12.09 and 12.04°C.
e) Average of 1.86 and 1.90°C.
f) Special cast for chemical samples. Depths estimated from wire angle.

SIO
STEP-I

OBSERVED								COMPUTED	
Z	T	S	O ₂	PO ₄ -P	SiO ₃	NO ₂ -N	δ_T	Z	$\Delta D'$
m	°C	‰	ml/L	µg at/L	µg at/L	µg at/L	10 ⁻⁵ cm ³ /g	m	dyn m

908

HORIZON; December 9, 1960; 1915 GCT; 16°28'N, 102°53'W; sounding, missing; wind, missing; weather, missing; sea, missing; wire angle, missing.

0a)	33.36	4.48	0.26	7	trace				
30	33.67	4.48	0.23	15	trace				
40	34.14	4.59	0.32	16	0.00				
49	34.31	4.60	0.42	12	0.02				
60	34.43	3.98	0.84	9	0.27				
147	34.84	0.14	2.38	33	0.00				
216	34.80	0.10	2.52	38	2.02				
266	34.79	0.17	2.56	40	2.46				
325	34.72	0.08	2.75	46	1.33				
384	34.67	0.10	2.82	53	0.90				
433	34.63	0.12	2.90	62	0.74				
492	34.60	0.12	3.01	73	0.60				
590	34.57	0.14	3.07	85	0.10				

90C

HORIZON; December 10, 1960; 1945 GCT; 19°18'N, 106°18'W; sounding, missing; wind, missing; weather, missing; sea, missing; wire angle, missing.

0a)	34.43	4.55	0.40	7	0.03				
39	34.79	4.54	0.44	11	0.00				
54	34.54	4.00	0.81	13	0.37				
74	34.57	1.38	1.99	24	0.07				
98	34.70	0.17	2.43	29	0.04				
128	34.76	0.21	2.54	37	trace				
167	34.78	0.08	2.56	37	2.06				
195	34.79	0.08	2.57	38	2.17				
244	34.75	0.10	2.64	40	1.82				
293	-	0.10	-	-	1.26				
342	-	0.10	-	55	0.50				
391	-	0.10	2.84	61	0.10				
489	34.56	0.11	3.01	70	0.00				
587	34.54	0.10	3.06	86	0.00				

90D

HORIZON; December 11, 1960; 2015 GCT; 22°08'N, 109°39'W; sounding, missing; wind, missing; weather, missing; sea, missing; wire angle, missing.

0a)	34.73	4.69	0.42	4	0.00				
46	35.00	4.62	0.50	7	0.00				
56	34.99	4.62	0.50	7	trace				
92	34.62	1.67	1.81	21	0.03				
117	34.65	0.81	2.22	26	trace				
140	34.62	0.49	2.43	32	0.00				
164	34.66	0.34	2.43	35	0.00				
186	34.63	0.39	2.54	37	0.00				
210	34.66	0.21	2.55	39	0.00				
232	34.72	0.13	2.60	39	0.00				
278	34.67	0.18	2.64	45	0.00				
324	34.65	0.16	2.70	48	0.08				
370	34.59	0.18	2.78	54	0.00				
461	-	0.17	-	-	0.00				

a) Special cast for chemical samples. Depths estimated from wire angle.

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